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The
REFINER
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JUL 22 1921
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New Vapor-Saving Devices for Class IV Tank Cars

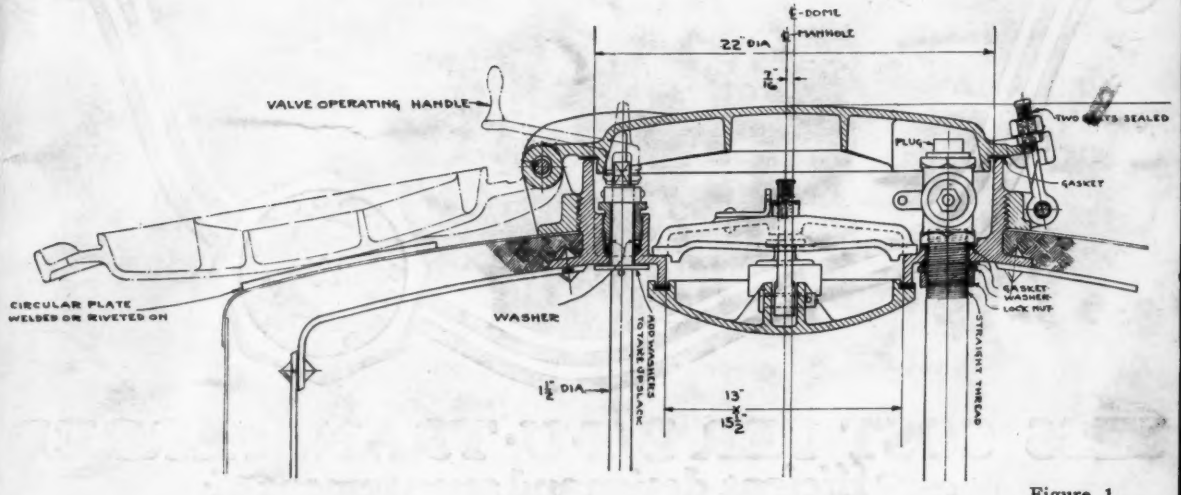

Figure 1

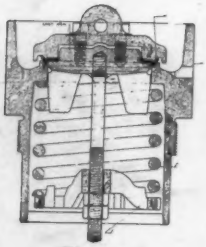

Figure 2

Figure 1 shows a new dome cover arrangement for Class IV Tank Cars which introduces a strong, gas-tight, pressure locking outer cover, a new internal hinged cover with two peep-sight holes, a new step gauge, a device for sampling contents without removing covers and means of loading and unloading without waste of gases.

Figure 2 shows a new patented Safety Valve with resilient gasket, recently approved by the A. R. A., which prevents escape of gases under 25 pounds pressure.

Cars are now being built by us with these devices.

Complete information on request.

American Car and Foundry Company

New York	Chicago	St. Louis
30 Church Street	Railway Exchange Building	915 Olive Street

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LESS COST PER B·T·U·TRANSFERRED

Efficient design and arrangement of heat transfer surfaces in BRAUN Heat Exchangers means lower first cost and operating expense and at no sacrifice of safety factors and operating and cleaning features

C·F·BRAUN & CO.

Manufacturing Mechanical Engineers

ALHAMBRA, CALIFORNIA

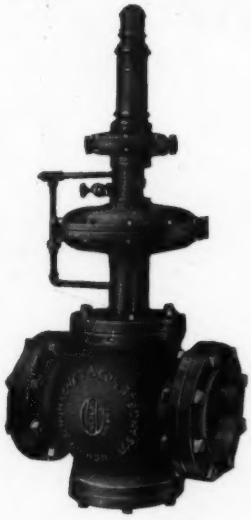
TULSA • DALLAS • NEW YORK

Entered as second class matter June 16th, 1923, at the Postoffice at Houston, Texas, under the Act of March 3, 1879.

Index bound in Vol. 6. I, Jan-June. 1927.

Extreme Sensitiveness No Variation of Pressure

The NEILAN Pilot Sensitive Back Pressure Regulator No. 45.



Designed especially for absorption plants.

The Neilan Pilot sensitive Back Pressure Regulator will maintain constant pressure on your absorption plant, without variation, regardless of widely varying load changes. The close, accurate, sensitive regulation will increase the yield of gasoline. When the plant pressure is constant, the pumping of absorption oil is steady and the oil in the absorbers will not carry over.

The improved construction of this regulator overcomes all the troubles encountered with ordinary weight-and-lever and spring-loaded types. It can be adjusted to maintain any back-pressure and any degree of sensitiveness. It will operate perfectly when the pressure on the outlet side is within one pound of the upstream pressure.

Simple in Design and Construction.
Absolutely Reliable. Trouble Proof.
Long Life.

Neilan, Schumacher & Co.

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Los Angeles, California

Branch Office: 626 Mayo Building, Tulsa, Okla.
P. H. Wilkinson, Manager.

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Pelican Well Tool & Supply Co., Shreveport, La.

"You Can Be Sure of Neilan Products"

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EVERY refinery official who is not already fully familiar with The ADAMANT Gun (the latest development in refractory guns) will want a copy of this new booklet.

It completely describes The ADAMANT Gun; illustrates its speed and effectiveness in applying refractory coatings on fire brick construction; and details its many advantages—low price ($25.00 in the United States); light-weight (less than 4 lbs.); compactness (measures only 10x18x4 inches).

If you haven't seen the new booklet on The ADAMANT Gun, write today for as many copies as you can use. You'll be glad to know how The ADAMANT Gun can help you curb the rising costs of refractory maintenance.

BOTFIELD REFRACTORIES CO.
783 S. Swanson St., Philadelphia, Pa.

For A Long Furnace Run, Use The ADAMANT *Gun*

ADAMANT
FIRE BRICK CEMENT

Whenever you use a fire brick, use ADAMANT, *the original high temperature cement*

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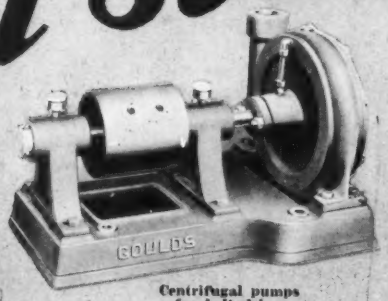
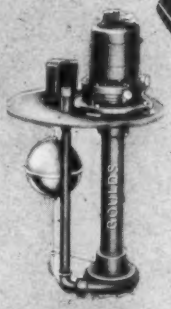
In stock—

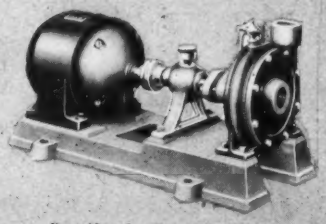
small power pumps for a multitude of purposes • • • •

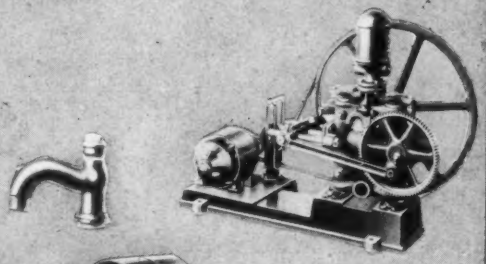


Centrifugal pumps for belt drive

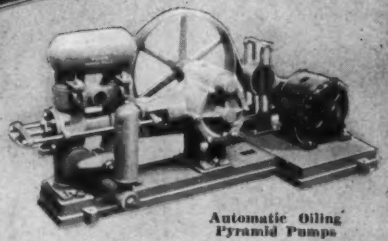


Automatic electric sump pumps


Centrifugal units with direct connected motors


"Pyramid" Motor Driven Outfits

Power Rotary Pumps


Automatic Oiling Pyramid Pumps

These small and medium capacity pumps are adaptable to a wide variety of uses in industrial plants of all kinds. Some of their many uses are:

Handling fuel oil, kerosene, and gasoline; unwatering excavations; pumping enamel, paint, varnish and other viscous liquids; loading and unloading tank cars; circulating liquids in manufacturing processes; circulating brine; booster service; water supply, etc.

Carried in stock at our factory, branch warehouses; and at mill supply houses everywhere.

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Centrifugal, Triplex, Rotary, Vacuum, etc., for
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Please send pump bulletins and specifications for
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Type B Oceco Conservation Vent Unit.

Oceco Safety Tank Winch No. 3.

Two units of a *complete* line of tank equipment.

Ask for the new Oceco Catalog

FOR years Oceco Equipment has been used by leading oil companies the world over.

It has stood the test of time.

In **OCECO** equipment you have this essential—this reliable evidence of satisfactory service *which no other test can give.*

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SAVES EVAPORATION AND PREVENTS FIRE

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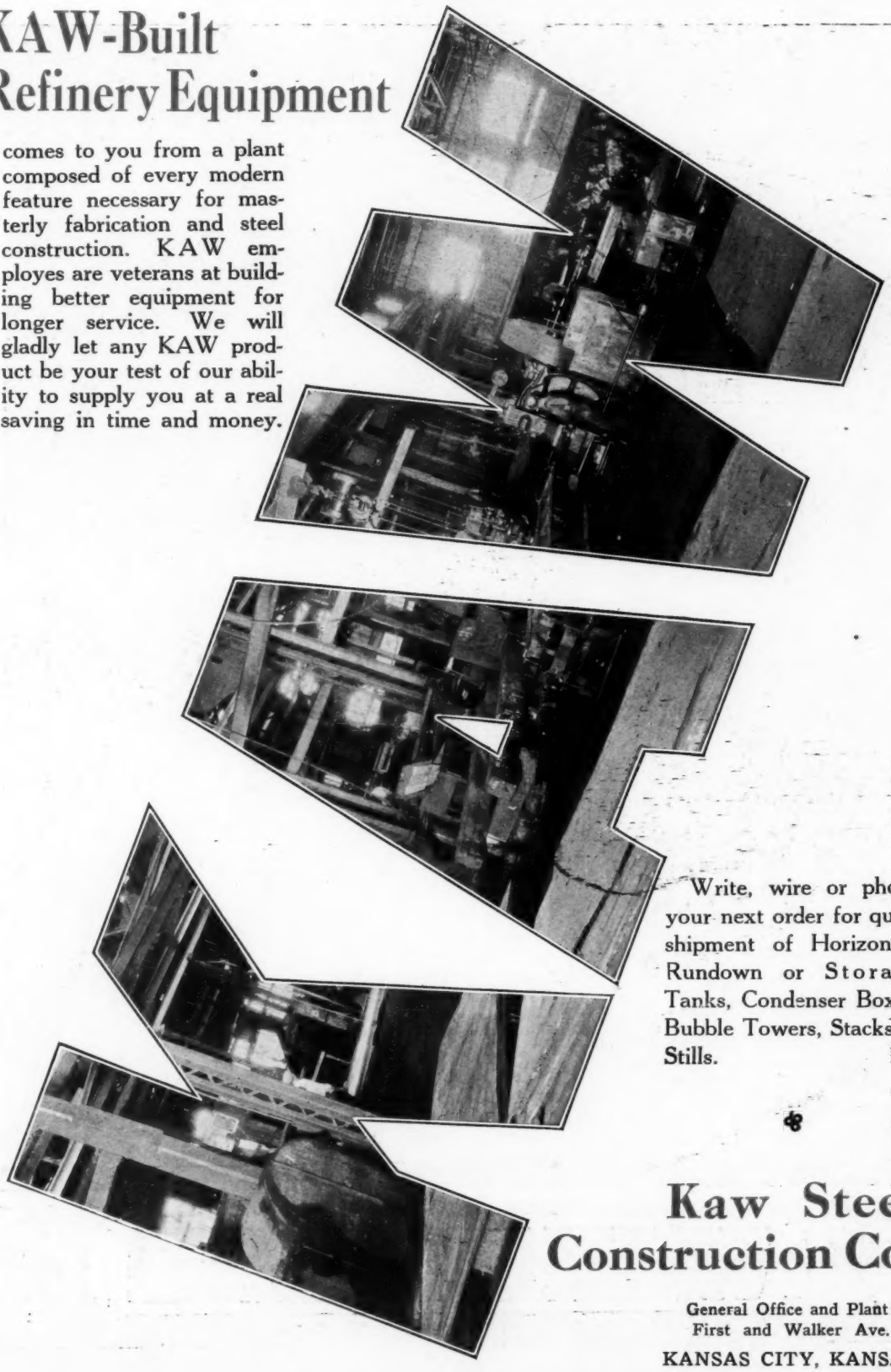
KAW-Built Refinery Equipment

comes to you from a plant composed of every modern feature necessary for masterly fabrication and steel construction. KAW employes are veterans at building better equipment for longer service. We will gladly let any KAW product be your test of our ability to supply you at a real saving in time and money.



Write, wire or phone your next order for quick shipment of Horizontal, Rundown or Storage Tanks, Condenser Boxes, Bubble Towers, Stacks or Stills.

Kaw Steel Construction Co.

General Office and Plant:
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MEASUREMENT & CONTROL

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[THE MASTER MIXER HEAD]
CROSBY STEAM GAUGES AND VALVES.
LIQUID SAFETY VALVES and companion line of safety tank equipment.
WESTCOTT ORIFICE METERS.
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CHAPLIN-FULTON high and low pressure regulators.
MERIAM MANOMETERS and companion line of Meriam Products.
MacDONALD 2Lt. 3 Diaphragm Meters equipped with 4 purging cocks for laboratory and charcoal testing.
BRISTOL'S CHARTS AND RECORDING GAUGES.
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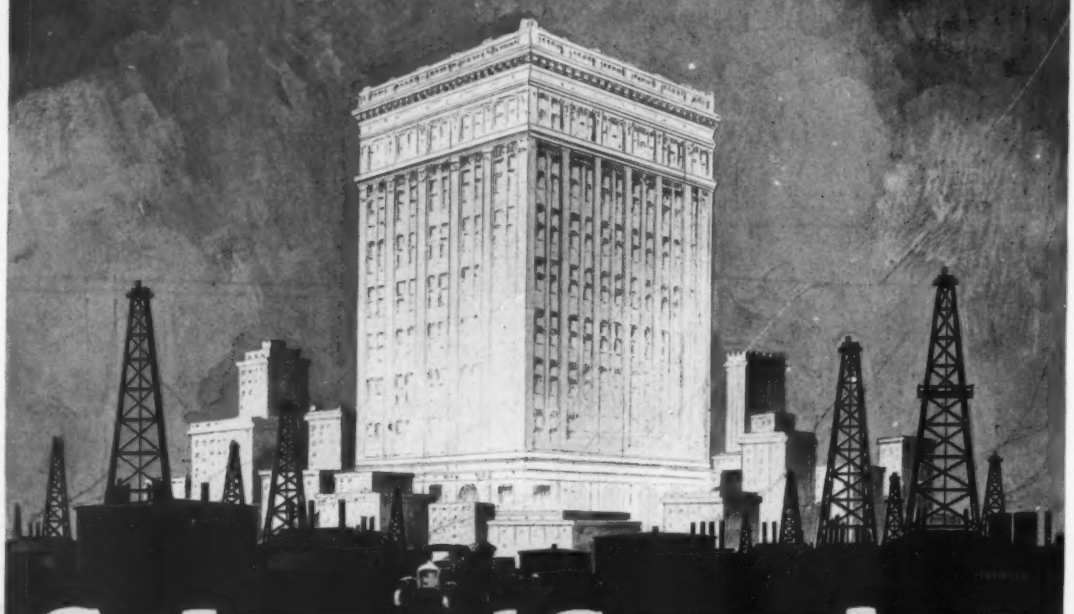

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WESTCOTT & GREIS
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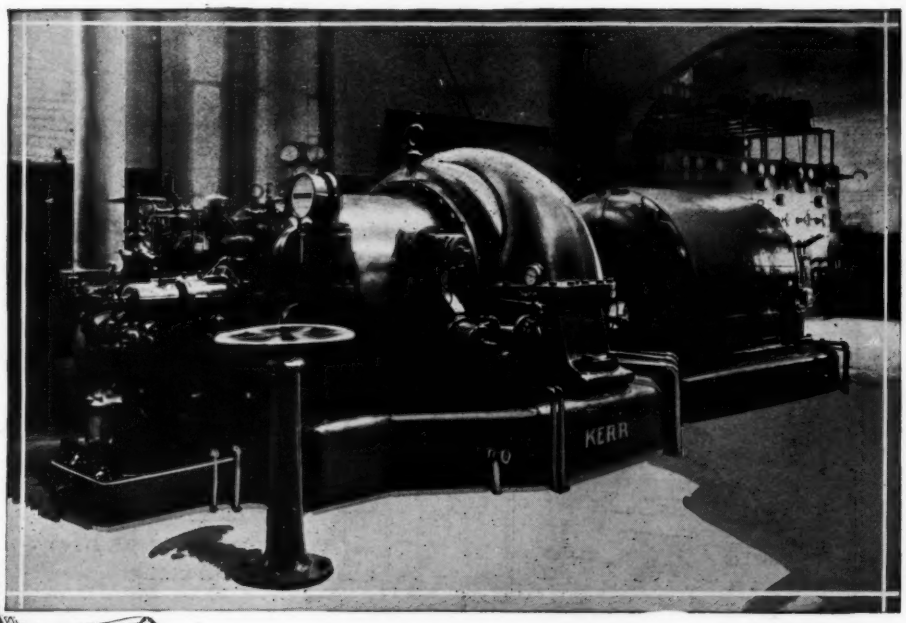

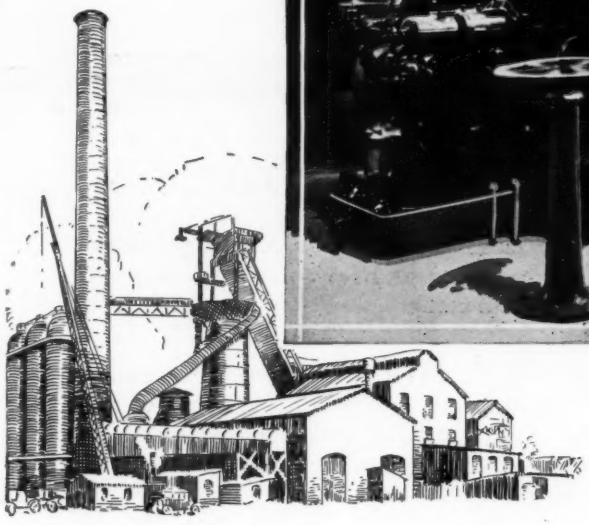

Reliability,

—for continuous operation, selected this unit

In their new $5,000,000 blast furnace and by-products coke plant at Troy, N. Y., the Hudson Valley Coke & Products Corporation figured it a wise investment to use high-grade equipment in the power plant even though waste fuel—blast furnace gas—was available in excess of the plant requirements, obviating any necessity for fuel economy. Such refinements as bleeder heating, the use of superheaters, efficient generating units, etc., were justified by the reduction in size and cost of the steam-generating equipment, and by the necessity for reliable, continuous operation.

The Elliott-Kerr 1000-kw. Turbine-Alternator generates 2300-volt alternating current, which is transformed to 250 volts. The Turbine is bled at 5-lb. gauge for feed heating.

The general manager of this company knows Elliott-Kerr Turbines are dependable. In 1914 he purchased 2—300-kw. Kerr Turbine-Generators when with W. J. Rainey, coal and coke operator at Uniontown, Pa. These turbines operated on a fluctuating coal-mine load with very bad steam and water conditions for a number of years without trouble. The next year he purchased a 750-kw. Elliott-Kerr Turbine-Generator for the same plant. Later, as general manager of another plant in Philadelphia, he had occasion to buy several Elliott Turbines or driving compressors, etc.

ELLIOTT TURBINES

for reliability

Elliott Power Equipment includes steam engines, generators and electrical machinery, condensers, deaerators, centrifugal blowers, and accessory equipment.

H-501

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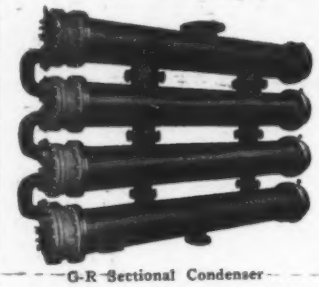
A gas cooler that saves space--labor--operating cost

Note these other G-R Units for lower refining costs



G-R Sectional Condenser

For condensing hydrocarbon vapors and other vapors

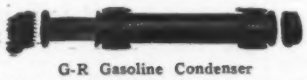
Can be used either as a standard or reflux condenser. The sectional arrangement permits using as a condenser and heat exchanger in one set or to obtain a different cut from each section.

Mineral Seal Oil Heat Exchangers

A compact, twin exchanger with strict counter-current flow to promote maximum of heat interchange.

G-R Jacket Water Cooler

Uses any source of raw water to cool the jacket water from oil and gas engines and compressors. The famous Multiwhirl Cooler—thousands in operation in every liquid cooling service.



G-R Gasoline Condenser

For condensing natural gasoline vapors in casinghead gasoline plants. Can also be used as a knockout box or fractionating tower control section with particularly close control of the end points.

G-R Twin Heat Exchanger

For the efficient interchange of heat between crude oil feed stock and still bottoms, cold water and hot oil.

The G-R Vaneflo Gas Cooler

can be operated as an inter-, after-, or pre-cooler for casinghead gas and is especially adapted to absorption and compression type natural gasoline plants.

This cooler saves space because its counter-current flow of gas and water, high rate of heat transfer, and the twin design in which it can be furnished result in the most compact construction on the market.

It saves labor because built so as to be easy to inspect, easy to clean, easy to erect, and easy to transport to new locations as required by changing plant conditions.

It saves operating cost because of its low gas pressure drop, sturdy, durable, trouble-proof construction, and highly efficient design.

THE GRISCOM-RUSSELL COMPANY

285 Madison Ave., New York

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Griscom-Russell Heat Transfer Apparatus

Mention Where You Saw the Advertisement

$2.50 per GALLON

for COOK'S READY-TO-MIX

ALUMINUM TANK PAINT

POPULAR demand and quantity production enable us to offer Cook's Ready-to-Mix Aluminum Tank Paint at this new low price.

Science has proved that Aluminum Paint, to be most effective, must be applied when freshly mixed. Because "you mix it on the job," Cook's Aluminum Tank Paint is always sure to be fresh. And because it *is* fresh, it has greater "leafing power," it wears better and reflects light and heat more effectively. The improved Cook package assures easy and foolproof mixing in exactly the right proportions—giving you bright, shiny, *new* paint, with a covering capacity of 750 square feet to the gallon. The greater leafing power of the fresh Aluminum "seals in" the paint, giving maximum wear and maximum heat reflection. One coat will do the work. It may be applied with either brush or spray.

When repainting over old paint, apply Cook's Aluminum Paint direct, without a priming coat.

Unpainted tanks require a priming coat, for which we recommend Cook's Rust Inhibitive Primer, in five gallon cans at $2.25 per gallon. Covering capacity, 500 square feet to the gallon.

Send us the dimensions or capacity of your tanks with your order; and we will send you the amount of paint you will need to do the job.

Prices quoted are F. O. B. at any of our factories or branches. Absolute satisfaction guaranteed or your money back.

Powder in the Small Bucket (A) Liquid in the Large Bucket (B) Together in a 5-Gallon Package

The large bucket "B" contains the Liquid and a separate bucket "A" which contains the Aluminum Powder. Remove the lid of the large bucket and take out the smaller Bucket containing Powder. Cut out the soft tin top of Bucket "A" and dump the Powder into the Liquid. Stir well with a wide, flat paddle that is long enough to reach the bottom of the large bucket.

Mix It on the Job as You Use It—

This *fresh* mixture gives a bright, shiny paint of superior quality, containing exactly the proper proportions of Powder and Liquid. Science has taught us that Aluminum Paint must be freshly mixed to be most effective. This unique Cook package assures *easy, foolproof mixing.*

Fight Sunshine with Cook's Tank Paint —Save 200 Barrels Yearly, Per Tank!

Government field tests on 55,000-barrel crude oil storage tanks show that Aluminum-painted tanks lose by evaporation 200 barrels less oil in a year's time than black tanks.

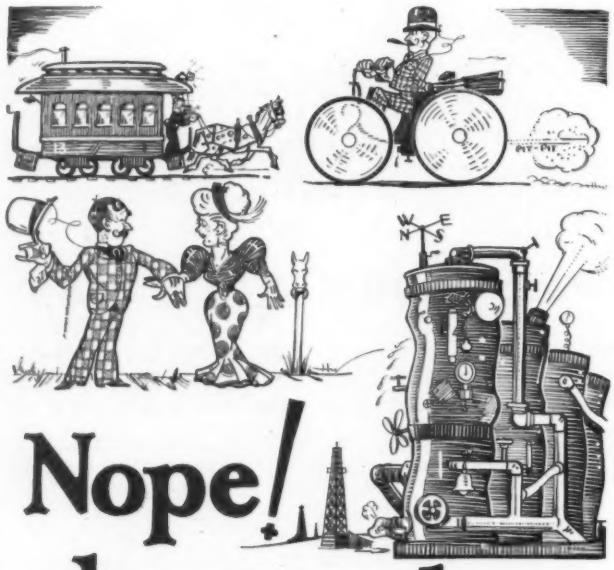
Black tanks absorb the heat from the sun's rays, causing excessive evaporation. Aluminum-painted tanks *reflect* the sun's rays, and thus remain cool. It's cheaper to paint a tank than to lose 200 barrels by evaporation!

Cook Paint and Varnish Company

Pioneers in the Manufacture of Specialized Paints for the Oil Industry

Factories: Kansas City, Fort Worth, St. Louis, Houston, Cincinnati

Branches: Chicago—Omaha—Wichita—Oklahoma City—Tulsa—Dallas—Denver—Kansas City, Kansas—St. Joseph, Missouri



Nope!

by-gone days *are* still here for some Absorption Plants !!

In the early days of gasoline production—and not so very long ago—almost any kind of baffle tower was used. Some absorption plant operators are still clinging to the obsolete while others are profiting by the installation of Campbell Oil-Froth Absorbers. If your plant is out-of-date let Campbell efficiency step in and increase your profits.

Ask for Catalog

J. A. Campbell

Natural Gas Engineer
Consulting—Designing—Construction
P. O. Box 669 LONG BEACH, CALIF.

CAMPBELL
OIL FROTH
absorber

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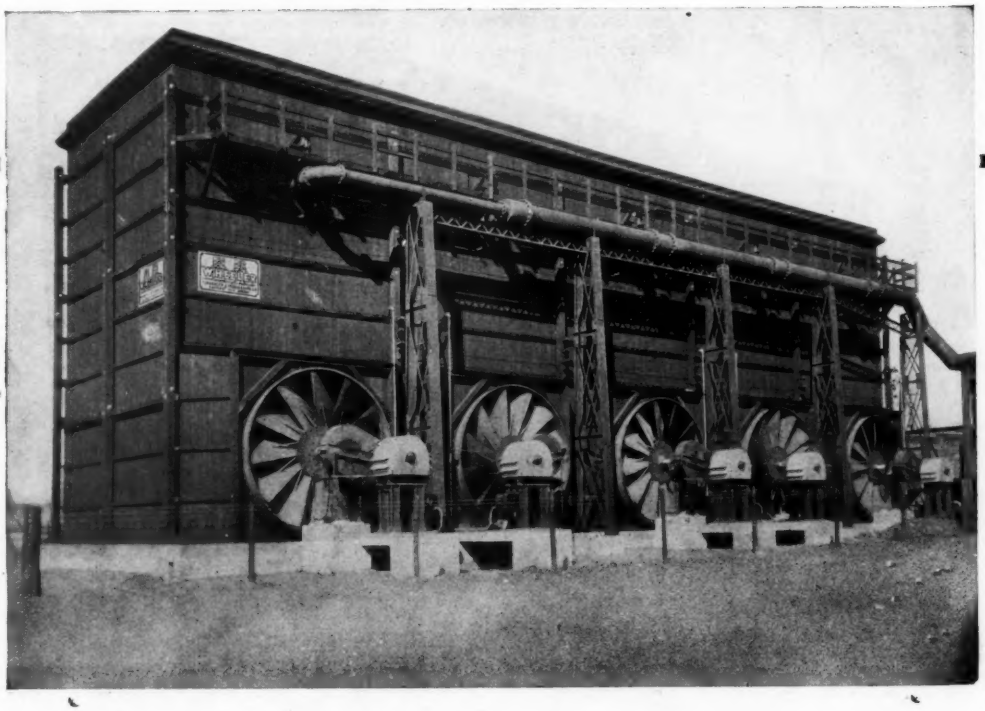

Plentiful Cooling Water

THE capacity of the tower shown above, installed in Oklahoma is 8700 gals. per min. of water from 101.8° F. to 85° F. when the outside air is 90° F. and 50% humidity. The use of fans to supply the draft for the tower puts every factor under control and provides a flexible installation which will always supply the rated amount of cool water under all wind conditions. All the factors are under the immediate control of the designer of the tower, so that any capacity and cooling range may be attained. Forced draft towers can be built in any size in a single unit and occupy less ground than any other water cooling means.

Write the Wheeler Condenser & Engineering Co. for information concerning the forced draft cooling tower, giving details as to the quantity of water to be cooled and atmospheric conditions. Wheeler towers are also made in the atmospheric and natural draft types.

WHEELER
CONDENSER & ENGINEERING CO.
Works. **CARTERET, N.J.**
and NEWBURGH, N.Y.
Main Office – 149 Broadway, New York City

WHEELER
Oil Refinery
Equipment

HEAT EXCHANGERS
(Liquid to Liquid)
VAPOR HEAT EXCHANGERS
FINAL CONDENSERS,
VACUUM CONDENSERS,
PARTIAL CONDENSERS
THERMO COMPRESSORS.

Other Products Include:

Cooling Towers,
Surface Condensers
Steam Jet Air Pumps
Expansion Joints,
Heaters,
Evaporators
Centrifugal Pumps,
Brass and Copper Tube and Pipe,

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Chicago
Cincinnati
Cleveland
Dallas
Denver
Havana
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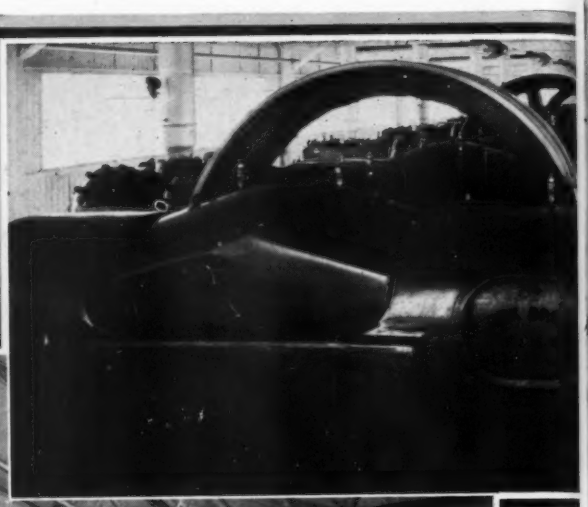
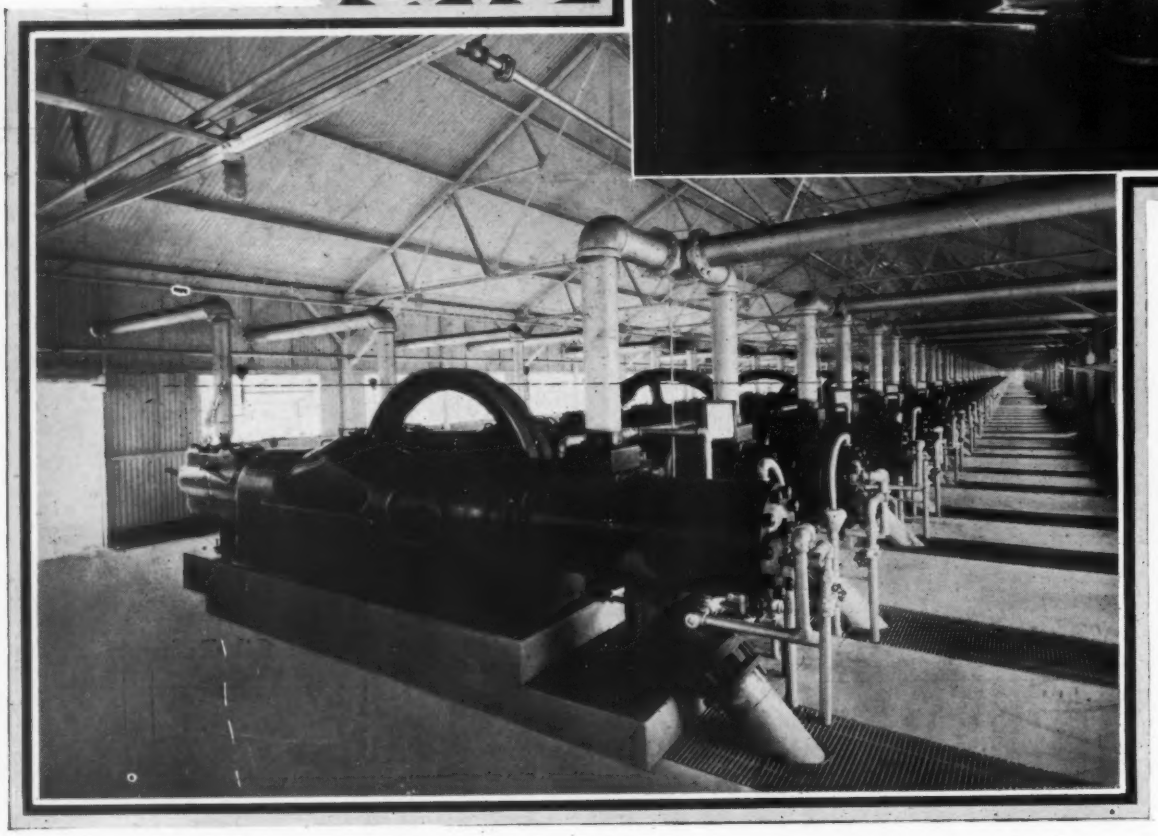
Clark Bros. Co.
OLEAN, N. Y.





Phillips Petroleum Company

CLARK BROS. COMPANY

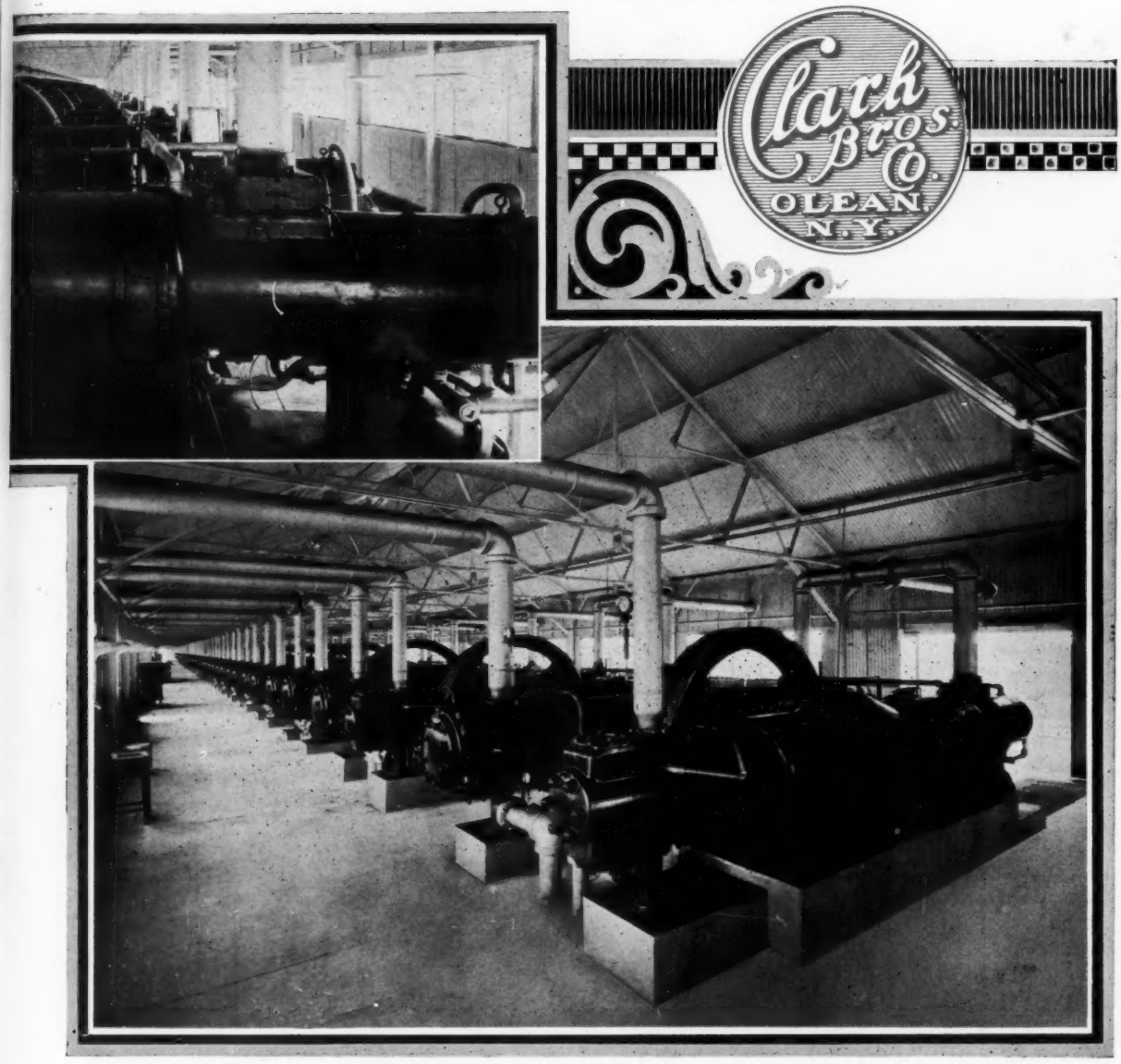
OLEAN, N. Y.

or

125 W. First Street,
TULSA

CLARK CON

Mention Where You Saw the Advertisement



...y 's Borger Plant - Borger, Tex.

Warehouses at McCamey and Sweetwater, Texas, and Artesia, New Mexico, or

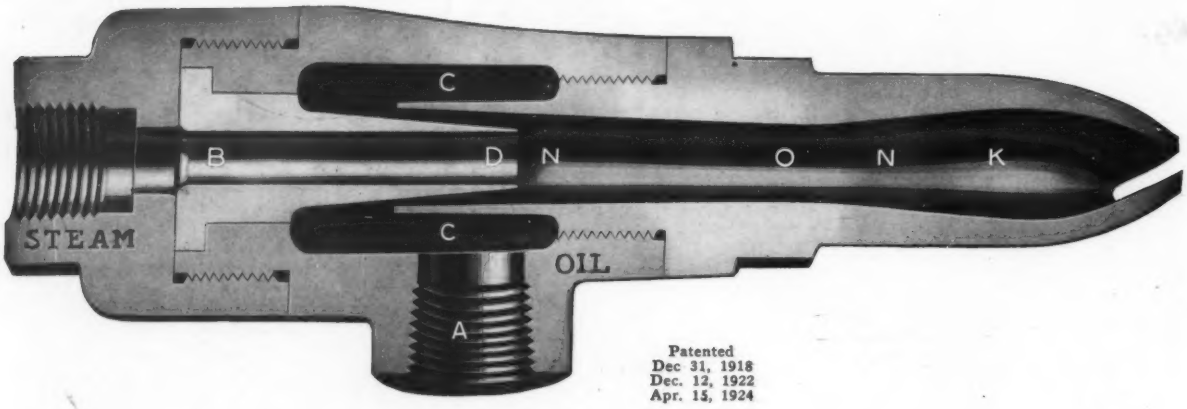
SMITH BOOTH USHER COMPANY

125 S. Central Ave., Los Angeles
50 Fremont St., San Francisco

...MPRESSORS

Mention Where You Saw the Advertisement

National Airoil Burners



Patented
Dec 31, 1918
Dec. 12, 1922
Apr. 15, 1924

For Power Plants and Stills and all Industrial Furnaces

NATIONAL AIROIL BURNERS
are internal atomizing burners—inside mixers —operating with either steam or compressed air; and burn as steady as a gas flame with any grade of fuel. Set your fire the way you want it, and it will burn the day through without watching or readjusting.

NATIONAL AIROIL BURNERS
will handle the heavy residuum from cracking stills without requiring continual removal for cleaning, an immense factor in economical plant operation.

NATIONAL AIROIL BURNERS
when operating under boilers will use less than one per cent of the steam for atomizing the oil. The old style steam atomizing burners use from three to seven per cent.

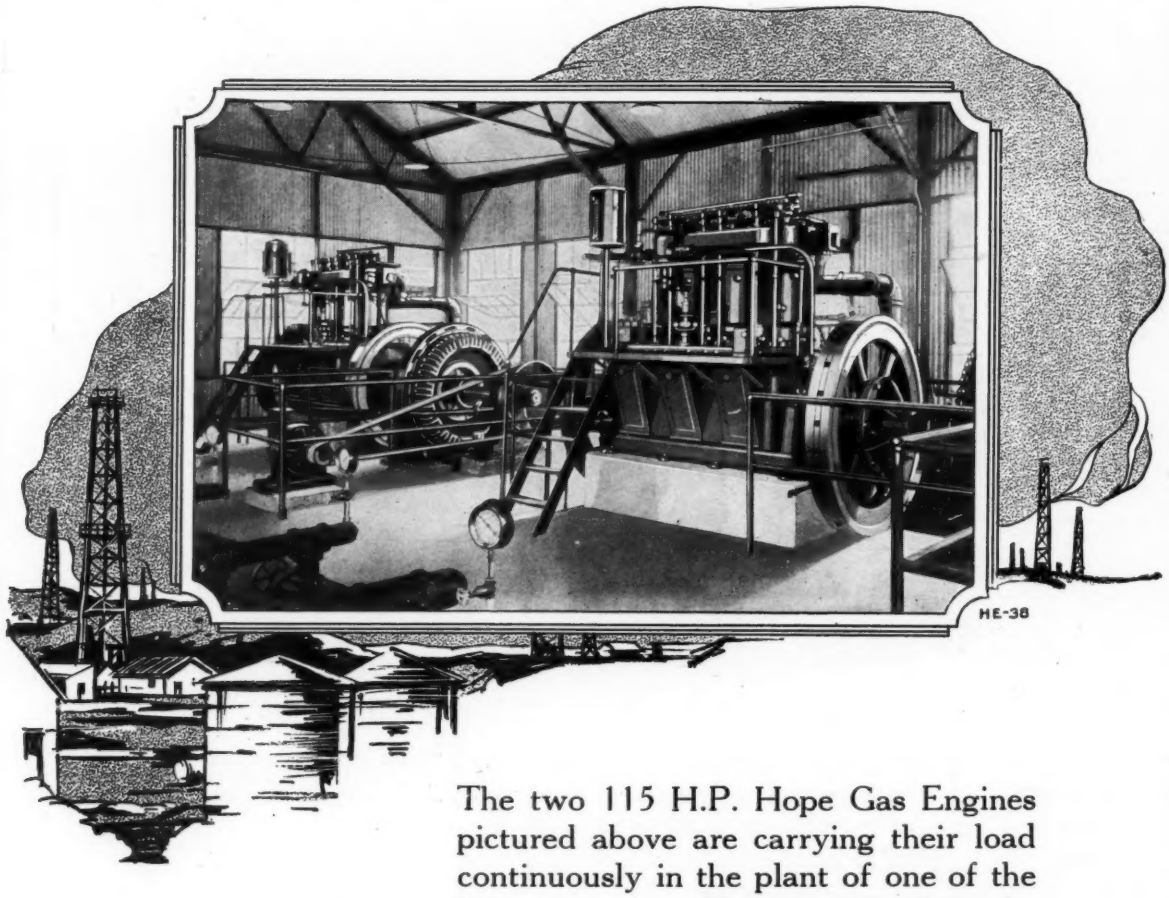
NATIONAL AIROIL BURNERS
give a soft gaseous flame that does not injure brick work or boiler tubes. Made with flat or round tips.

Write for our Bulletin No. 21

National Airoil Burner Company

Factory: S. W. Cor. 9th and Thompson Sts.
Sales Rooms: 1327 Girard Avenue
PHILADELPHIA, PA.

Oil Burners and Oil Burning Equipment



The two 115 H.P. Hope Gas Engines pictured above are carrying their load continuously in the plant of one of the big companies. They are furnishing dependable power at minimum cost for lighting and auxiliaries, helping to keep up the high production and low cost that mean good, steady profits. Hope Gas Engines have that in-built dependability that, as every modern operator knows, is at the root of economical operation.

HOPE Gas Engines for Dependable Auxiliary Power

Ask us for specifications on the size of unit you need.

ENGINEERS CONTRACTORS

HOPE ENGINEERING AND SUPPLY COMPANY

DESIGNERS MANUFACTURERS

MOUNT VERNON, OHIO, U.S.A.

DALLAS, TEX. TULSA, OKLA. CASPER, WYO.

Mention Where You Saw the Advertisement

Banroc's *NEWEST* Cost Reducer

THE demand for insulation of higher efficiency and lower cost has been met so completely by BANROC that it is now used in four out of every five refineries in the country.

—Banroc meets this two-way demand perfectly—highest efficiency—yet lowest cost.

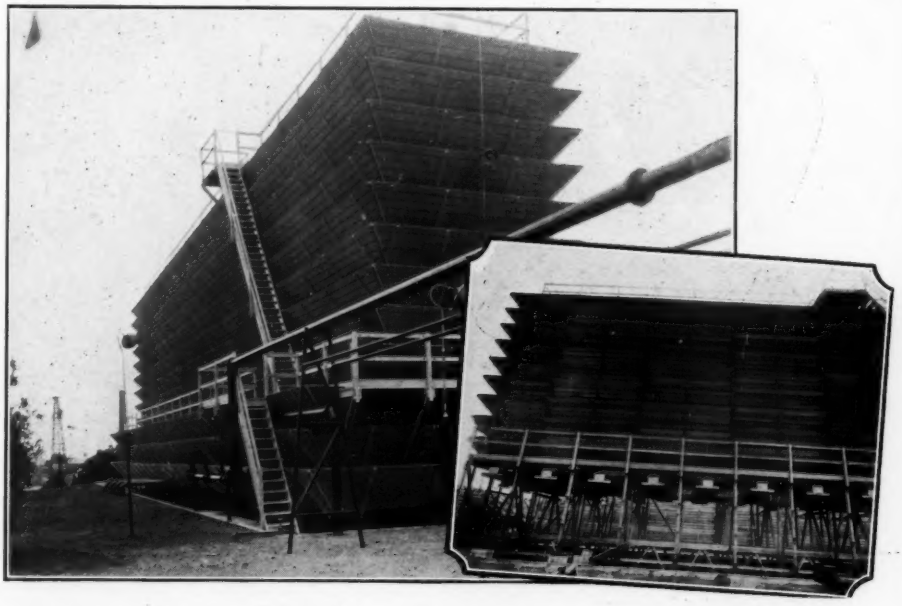
And now comes Banroc's newest cost reducer—BANROC METAL COVERED PIPE INSULATION—New—yet tested and approved by some of the largest refineries in the business.

We have a new bulletin that describes this wonderful new pipe insulation in detail. It will be sent on request. Write today.

BANROC
METAL COVERED PIPE INSULATION

BANNER ROCK PRODUCTS COMPANY
ALEXANDRIA, INDIANA

ORIGINATORS OF ROCK WOOL PRODUCTS



The New FLUOR COOLING TOWER For Open Type Coolers

First, the water is cooled in the most efficient type of cooling tower, after which it is collected into the longitudinal flume above the open coolers. Cold water is then distributed to the stands of the coolers in quantities desired. The water can be shut off from any stand of coolers at any time for inspection, cleaning or repairs. Coolers can be removed or replaced while the tower is in operation. The installation can be extended easily and conveniently.

Fluor Towers are manufactured of the finest redwood. Standard design permits immediate shipment.

AND .. .. .. in spite of the highest quality and workmanship, our unequalled quantity production keeps our prices low .. .. .. invariably below the cost of home-built towers of comparable materials and performance. Get our prices on your requirements

FLUOR CONSTRUCTION COMPANY

Constructors and Engineers

909 E. 59TH ST
LOS ANGELES, CALIF.

502 NATIONAL BANK OF COMMERCE BLDG.,
KENNEDY BLDG.,

FLUOR REDWOOD COOLING TOWERS

Mention Where You Saw the Advertisement

Still Temperature Control

Grasp the clock key in the right hand. Turn until the control point of the Foxboro Automatic Temperature Recorder - Controller reaches the exact degree of temperature desired. That's all. This accurate, dependable instrument does the rest.

This Foxboro Temperature Recorder-Controller is DIRECTLY SET

Still temperatures are held as desired. Finer cut fractions result. Re-runs become a legend instead of a daily menace. No reason for shipments not coming up to specifications.

The Foxboro Automatic Temperature Recorder-Controller requires no more attention than any good recording instrument. It is guaranteed permanent in calibration and is accurate to within less than 1 per cent of total scale range. Get in touch with our nearest branch office which is equipped to give you immediate attention.

The Foxboro Co., Inc.

Neponset Avenue, Foxboro, Mass., U. S. A.
205 So. Cheyenne Avenue, Tulsa, Okla.

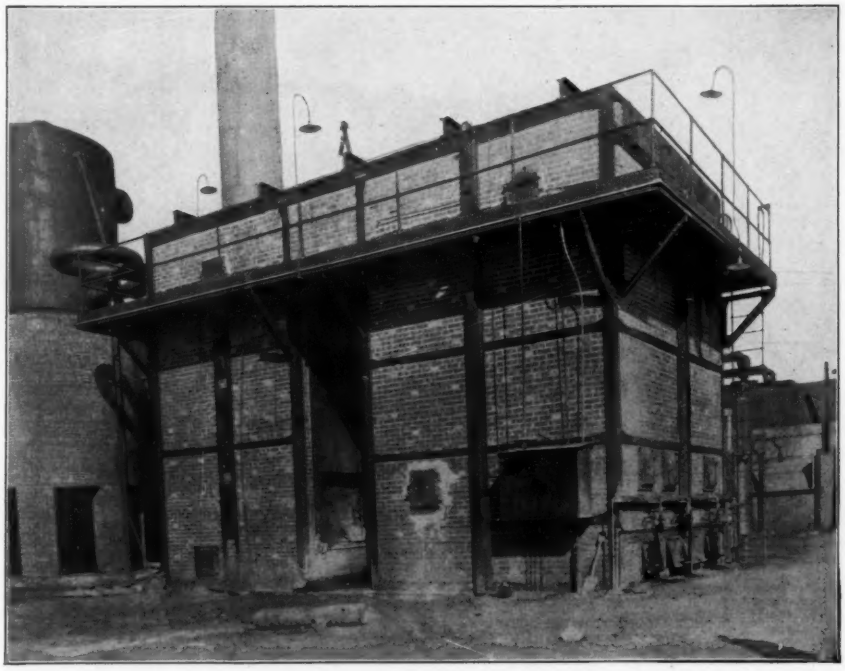
NEW YORK CHICAGO BOSTON PHILADELPHIA PITTSBURGH CLEVELAND ROCHESTER ATLANTA
LOS ANGELES SAN FRANCISCO PORTLAND, ORE., DETROIT

PEACOCK BROTHERS, *Limited*
1605 Delorimier Avenue
Montreal, Canada

FOXBORO
REG. U. S. PAT. OFF.
THE COMPASS OF INDUSTRY

Sole British Representatives:
WALKER-CROSWELLER & Co.
58 Queen Elizabeth Street
London, S. E.

Instruments for Indicating, Recording and Controlling Temperature, Pressure, Humidity and Flow



HIGH TEMPERATURES WITHOUT OVERHEATING

Foster Tube Stills are successfully heating oil to final temperatures as high as 1100 deg. Fahr. without overheating the oil or the heater, and in some installations are successfully taking an overhead of 90 per cent of the throughput without cracking.

Performances such as these form one reason for the rapidly increasing number of Foster Tube Still installations—now in excess of 500.

POWER SPECIALTY COMPANY
111 Broadway, New York
Branches in all Oil Centers

FOSTER
The TUBE STILLS
with the protected surface

NATURAL GASOLINE

FLEXIBILITY

Flexibitity of motor performance depends upon the even burning, non-detonating qualities of the fuel.

To be even burning a motor fuel must be volatile, properly balanced as to boiling points, quickly responsive to throttle changes.

Refiners are using steadily increasing quantities of

NATURAL GASOLINE

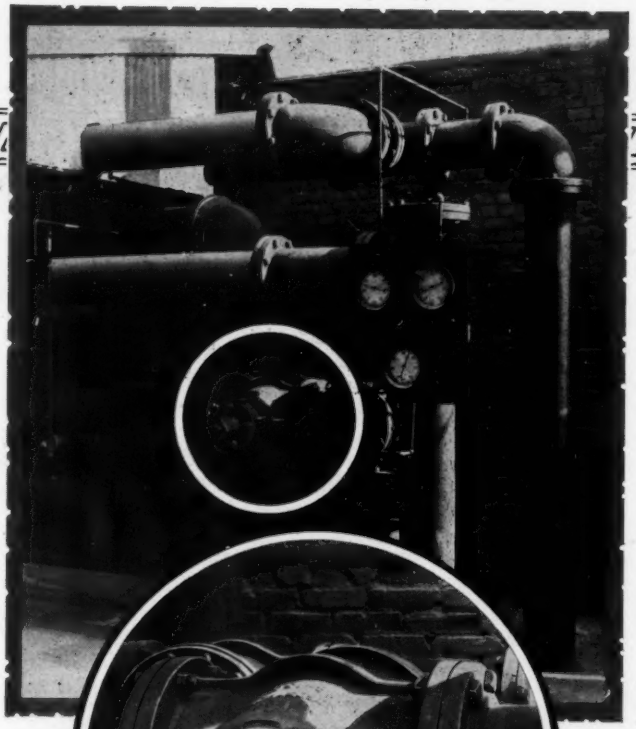
in their blends with refined gasoline to increase volatility, giving to the finished fuel the qualities necessary to secure maximum motor performance.

Refiners find in the bulletins issued by the Research Department, Association of Natural Gasoline Manufacturers, Cosden Building, Tulsa, Okla., much useful information regarding motor fuels. Write for these bulletins.

ASSOCIATION OF NATURAL GASOLINE MANUFACTURERS

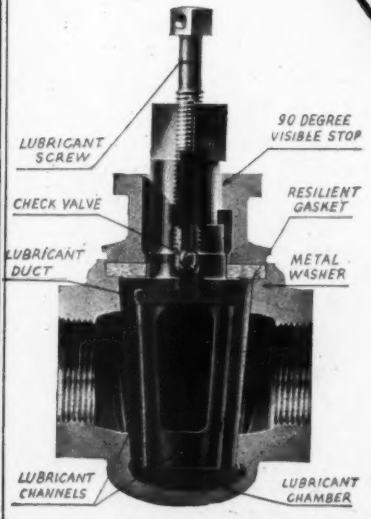
RESEARCH DEPARTMENT ASSOCIATION OF NATURAL GASOLINE MANUFACTURERS

Perfect Valve Control!



Merco Nordstrom Plug Valves

Won't leak
Won't stick



The bearing surface in a Merco Nordstrom is completely lubricated. Afters months of disuse the valve may be closed or opened freely by merely a slight turn of the lubricant screw which lifts the plug from its seat.

The Perfect Valve for Refining Service.
Sizes ½-inch to 24-inches. Ask for Catalog.

MERCO NORDSTROM VALVE CO.

SUBSIDIARY OF THE MERRILL COMPANY

Engineers—

San Francisco, 121 Second St.
Chicago, Peoples Gas Building
Cleveland, Ohio, 325 Engineers Building

MERCO

Manufacturers

New York, 11 W. 42nd St.
Houston, 1315 Petroleum Bldg.
New Orleans, 1501 Masonic Temple Bldg.

Western Factory: Oakland, California
Eastern Factory: Belleville, New Jersey

AGENCIES IN PRINCIPAL CITIES

Mention Where You Saw the Advertisement

This Quick, Sure Test Proves Its Dependability

This shows how the BUCK TYPE "C" VALVE is proved by a second's test, at any time, without tools or bother. Both Vacuum and Pressure valves are raised from their seats by pressing up on the exposed stem with the finger. This test is absolutely positive. It proves the dependable free working of the Valve, summer or winter.

BUCK
Type C Tank Valves

Here is the STOCK TANK VALVE that makes "Gas Tight" Tanks really Gas Tight.

Your lease men know by bitter experience that with ordinary valves it is better to leave Tanks open than to bulge a Tank or pull in a deck.

Now—with this Valve—there is no loss of gasoline vapor or gravity, nor bulged and damaged tanks. Lease men can welcome positive orders to keep Thief and Man Holes tightly closed. They can be sure—day or night, summer or winter—that your Stock Tanks are fully protected and safe.

Stock Tanks rigged with BUCK TYPE "C" VALVES do away with open Thief Holes and Man Holes.

Big, Generous Capacity

The BUCK TYPE "C" STOCK TANK VALVE takes care of pressure built up by gravity lines flowing as much as 1,000 barrels per hour. It prevents Tanks from being pulled in, even when pumping out over 750 barrels per hour.

Tests by government authority show that BUCK TYPE "C" VALVES not only have capacity surprisingly greater than others—but that *as gas volume passed through the valve increases there is an actual drop in pressure,* due to the advanced scientific design. That means that an unusually heavy slug of gas won't bulge your tanks.

Experience and Research

Construction and Material the Result of Long

Valves are of special bronze, developed for toughness, strength and resistance to corrosion. Service on tanks in the Panhandle and McCamey, Texas, fields has shown them to be extremely resistant to sulphurous gases.

Valve guides are not exposed to the tank vapors. Freezing vapors or parafin can't stick them. Spraying wells have so coated the outside of the valves with parafin that they were unrecognizable as valves—yet they functioned perfectly.

Constant Correct Pressures—No Springs

There are no springs to weaken, rust or break. The valves are weighted for correct relief, and cannot change. The pressure settings are readily changed by putting in other valves, which are interchangeable over a wide range of pressures and vacuums.

Self Draining Valve Casing

The Valve Casing is shaped to drain oil and condensed vapor back into the Tank and *away from the valves and valve seats.* Thus the valves and seats are always clean and tight.

The gas passages through the valve casing are designed for stream line flow of gas. This careful design explains the large capacity of BUCK TYPE "C" VALVES.

Non-Chattering Valves

The faces of the valves, the stream line gas passages and the carefully designed bonnets are all so shaped as to eliminate chatter. Valves are consequently long lived. Worn and leaky valves are prevented.

The Bonnets fully protect the valves from rain, snow and sleet. BUCK TYPE "C" VALVES are made for service and dependability. They are economical in cost and profitable in use. Made for all purposes of dependable Tank Venting:

3" Size, for Stock Tanks, Refinery Run Down Tanks, etc.

6" Size, for Flow Tanks, Pipe Line and Refinery Storage Tanks, etc.

8" Size, for Large Tight Storage Tanks.

Rapidly Becoming Standard Equipment on Regular Specifications

BUCK TYPE "C" VALVES already are Standard Equipment with many leading Oil Companies, Refiners, Tank Manufacturers and Tank Erectors. They have earned this place on their record in actual use.

Make them your standard specification and you will get "Real Gas Tight Insurance for Gas Tight Tanks."

Ask for our Bulletin No. 3, which describes BUCK TYPE "C" VALVES and other time tried valve equipment. Sent promptly on request.

G-B MFG. CO. KANSAS CITY, MO.

BUCK OIL CONSERVATION EQUIPMENT

Type A Sensitive Regulators
Casing Head Regulators
Liquid Level Controllers
Tank Valves and Equipment
Oil and Gas Separators
Oil Field Supplies

BELTING
Rubber Canvas
Leather Cotton
Balata

HOSE
Air Fire
Oil Steam
Water

PACKING
Asbestos Hemp
Flax Rubber
Leather

GASKETS
Rubber Asbestos
Leather Fiber

WASTE
White Colored
Wool

MISC'L
Matting Drills
Pulleys Picks
Shovels

Gustin-Bacon Mfg. Co.
Vacuum Control Division
Kansas City, Mo. Tulsa, Oklahoma

FIGHTING OIL FIRES

The Associated Oil Company equipped this fire-pump station with an EC&M Automatic Compensator for starting the pump motor because:

Push-button control makes it impossible for any one to start the motor incorrectly.

Being totally oil immersed, the working parts are kept clean and lubricated at all times, and the starter will function properly no matter how long it has stood idle.

Being built right mechanically and having a large margin of safety in contacts and other electrical parts, it is free from trouble.

It needs inspection only once a year.

EC&M Automatic Compensator

See Our Exhibit at the International Petroleum Exposition, Tulsa, Okla., Sept. 24th to Oct. 1st.

Send for Bulletin 1042-F Describing EC&M Automatic Compensators

THE ELECTRIC CONTROLLER & MFG. CO.

CLEVELAND, OHIO

NEW YORK-50 CHURCH ST. CHICAGO-CONWAY BLDG. DETROIT-DIME BANK BLDG. BIRMINGHAM-BROWN-MARX BLDG. CINCINNATI-1ST NATIONAL BANK BLDG. MONTREAL-DRUMMOND BLDG. LOS ANGELES-AMERICAN BANK BLDG. SALT LAKE CITY-228 W. SO. TEMPLE TORONTO-REFORD BLDG. PHILADELPHIA-WITHERSPOON BLDG. PITTSBURGH-OLIVER BLDG. SAN FRANCISCO-CALL BUILDING SEATTLE-570 COLMAN BLDG. TULSA-217 E. ARCHER ST.

Mention Where You Saw the Advertisement

FISHER
in the field

In the gas line where an accurate vacuum must be maintained, the Fisher Vacuum Regulators will perform dependably. There is a type to meet your requirements.

Type 86—An ultra-sensitive, all-metal self-enclosed vacuum regulator. Will hold positive down to ½-inch of mercury on inlet side. Type 88—Will regulate any vacuum on inlet side. If desired can carry 3 lbs. pressure on inlet side and vacuum on outlet. Type 87—Casing head self-enclosed combination Back Pressure and Vacuum Regulator. Eliminates friction due to dirt, sand, snow or sleet.

The Fisher Gas Pressure Regulator is another piece of precision equipment that has won the confidence of the Oil Industry through consistent performance.

The great variety of types of pressure regulators enables you to choose just the regulator for your particular service. In addition to various ranges of pressures, which give us an opportunity of serving you, we have a large variety of combinations of expanded outlet sizes. Write for illustrated catalogue of the entire Fisher line.

To the left is shown a picture of the Fisher Ultra-Sensative Vacuum Regulator Type 86, holding vacuum of 5 inches on an oil and gas well.

THE FISHER GOVERNOR CO.

1315 Fisher Building

MARSHALLTOWN, IOWA, U. S. A.

Mention Where You Saw the Advertisement

SOUTHWESTERN
FACTORY BUILT

ABSORPTION PLANTS

A Factory Built Plant for every condition & capacity

Type 25 (PORTABLE) 2,500 to 3,000 Gallons

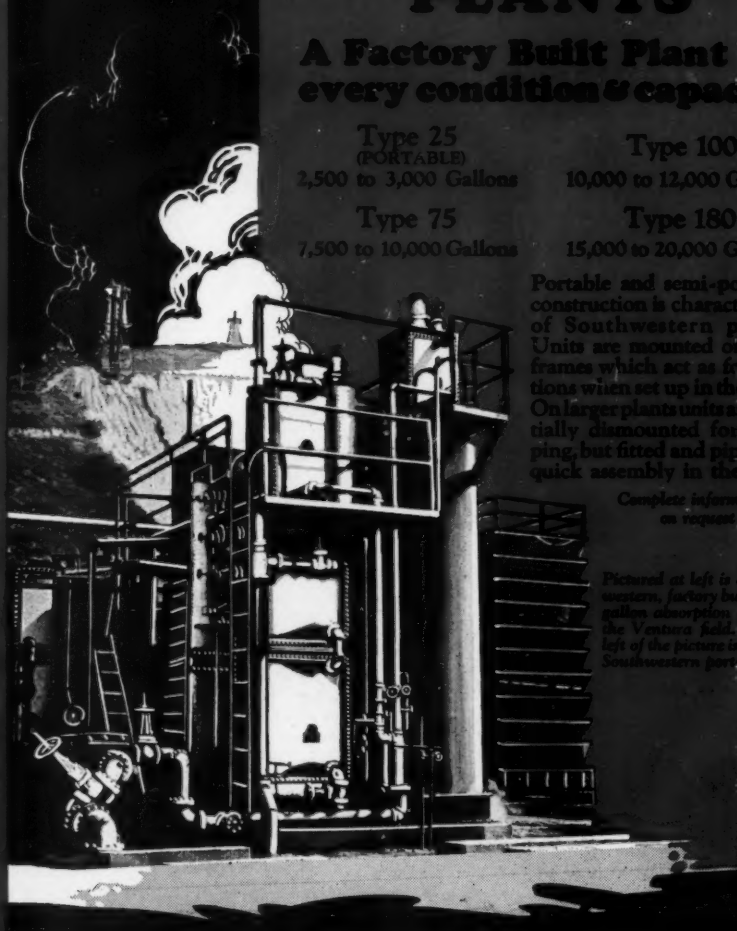
Type 100 10,000 to 12,000 Gallons

Type 75 7,500 to 10,000 Gallons

Type 180 15,000 to 20,000 Gallons

Portable and semi-portable construction is characteristic of Southwestern plants. Units are mounted on steel frames which act as foundations when set up in the field. On larger plants units are partially dismounted for shipping, but fitted and piped for quick assembly in the field.

Complete information on request



Pictured at left is a Southwestern, factory built, 7500 gallon absorption plant in the Ventura field. At the left of the picture is a small Southwestern portable.

SOUTHWESTERN ENGINEERING CORPORATION LOS ANGELES U.S.A.

SOUTHWESTERN ENGINEERING CORP.

1221 HOLLINGSWORTH BLDG.

Los Angeles, Calif.

Offices: TULSA, AMARILLO, TEXAS, NEW YORK

Factories: CULVER CITY, CAL., TULSA

SAFEMCO PAINTS

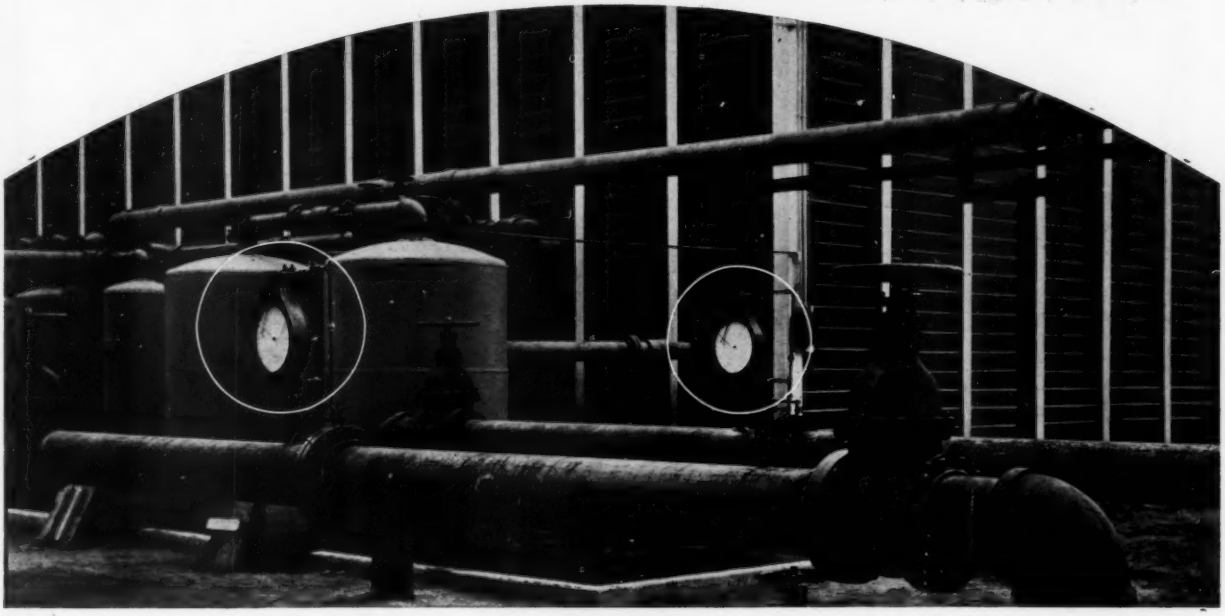
All Over the Southwest!

Used and Recommended by Largest Oil Companies

AMERICAN PAINT & SUPPLY COMPANY

DALLAS, TEXAS

METRIC orifice METERS



PUT *SURE* IN MEA *SURE* MENT

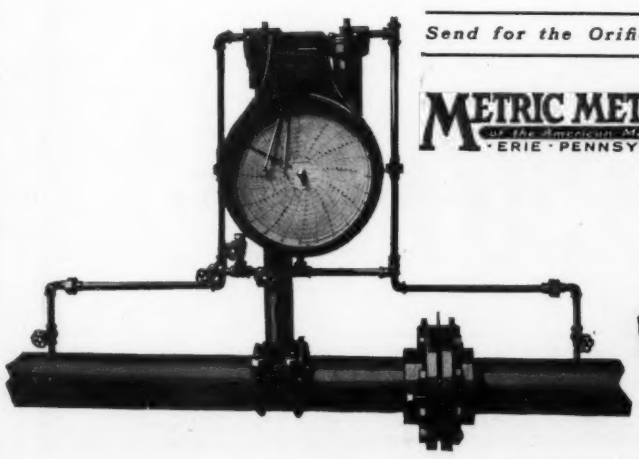
Unexcelled

Orifice meters, as made by Metric Metal Works, have every requisite characteristic for accuracy. * * * They are compact and readily installed anywhere. * * * The float is kept parallel with the mercury, permitting quick adjustments. * * * Lost motion is practically eliminated. Friction is reduced to almost nothing. * * * The area of float is so large that any reasonable friction existing is overpowered and neutralized insofar as affecting the operating accuracy of the meter. * * * Low pressure tests can be run with the mechanism open for the tester to make adjustments easily. * * * There is an automatic door latch and pen lifter, with the chart hub cap connected to the case with a chain, but in such a manner that the chain does not come into contact with the chart. * * * The chain cannot deface the record by spreading the ink. * * * All these features are embodied in a Meter of attractive appearance, having a black-enameled, die-cast, aluminum case and joints sealed with felt gaskets to render dust and moisture-proof protection to all working parts. * * * For accurate measurement Metric Orifice Meters are **UNEXCELLED.**

WESTCOTT & GREIS

Sales Service

Dallas TULSA Los Angeles

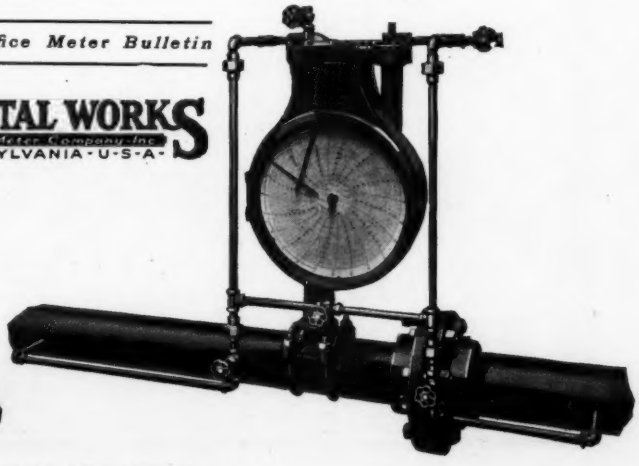


Send for the Orifice Meter Bulletin

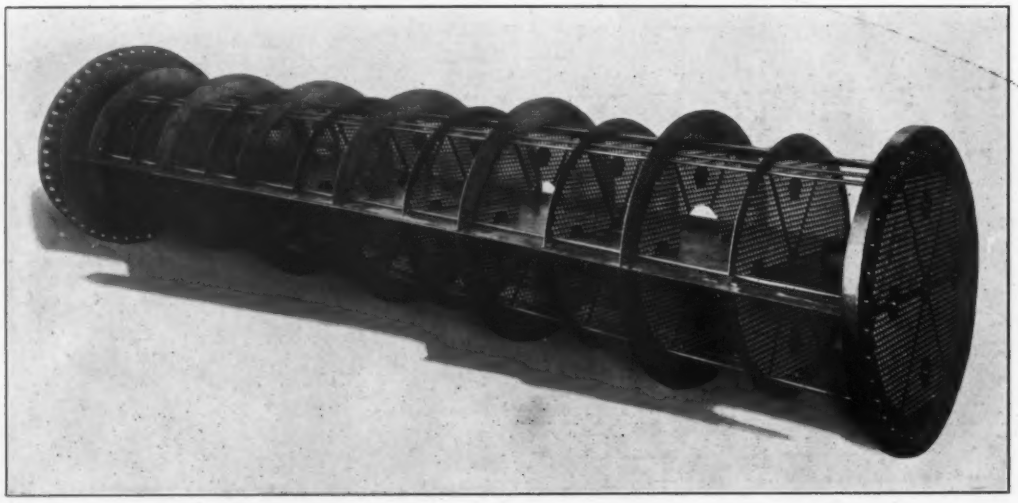
METRIC METAL WORKS

of the American Meter Company, Inc.

ERIE · PENNSYLVANIA · U·S·A



Mention Where You Saw the Advertisement



We Are Not Limited to Standard Units But Furnish What Your Conditions Require

This illustration shows the assembled tube heads and baffles ready to receive the tubes for a 2900 sq. ft. unit. Made entirely of Admiralty metal.

The special tube expander we use eliminates any chance of tubes ever leaking.

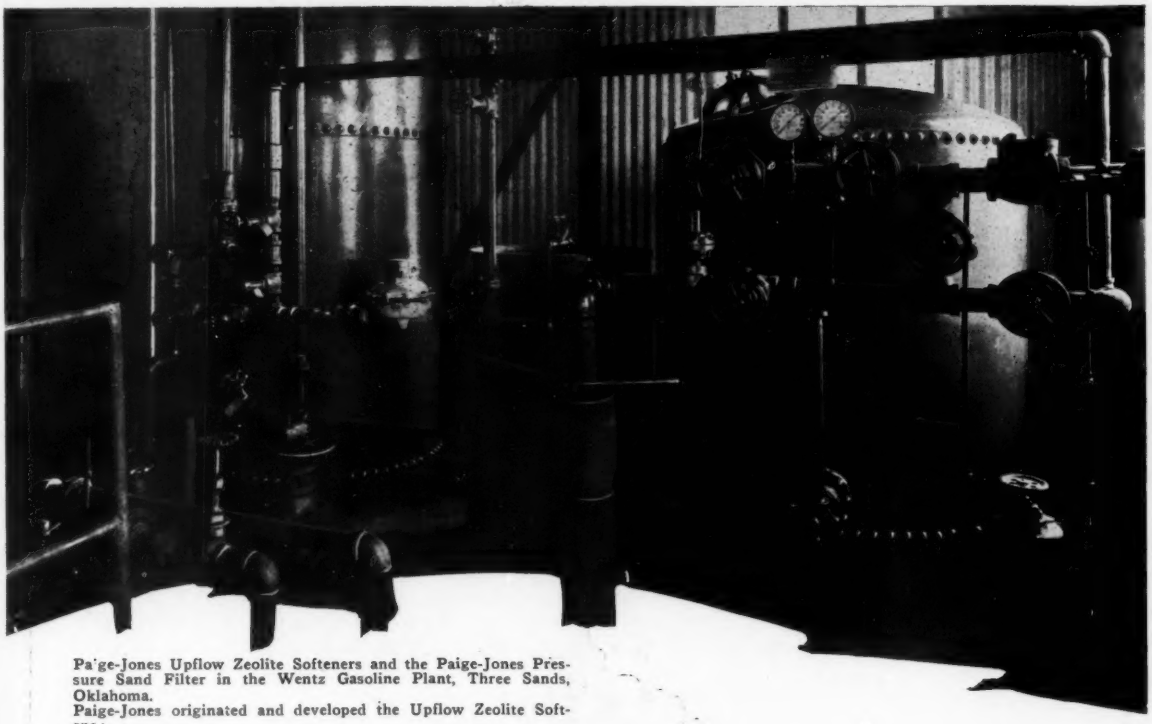
Ross Heater & Mfg. Co., Inc.

BUFFALO, N. Y.

Representatives in all principal cities

Mention Where You Saw the Advertisement

Circulate *Softened* Water and Cut Down Costs



Paige-Jones Upflow Zeolite Softeners and the Paige-Jones Pressure Sand Filter in the Wentz Gasoline Plant, Three Sands, Oklahoma.
Paige-Jones originated and developed the Upflow Zeolite Softener.

The Gilmore Oil Co. writes:

"Before installing the Softener (Paige-Jones), our cost for condenser cleaning ran approximately $1,000.00 a year and this has been entirely eliminated."

The Shaffer Oil and Refining Company Writes:

"Before we installed the Softener (Paige-Jones), we found it necessary to shut our engines down approximately every ten days and remove the scale from the jackets. We have practically eliminated all cracked cylinder heads and it is very uncommon to find scale in our engine jackets."

SOFTENED water for condenser coils keeps the coils clean and increases cooling efficiency. Softened water in cooling jackets protects the engine. No scale will form—cylinder heads will not crack.

For these purposes alone, it would pay refineries, gasoline plants and pumping stations to install water softeners.

Those plants—and they are many—that are using Paige-Jones Upflow Zeolite Softeners are reporting lowered operating and maintenance costs.

A Paige-Jones representative is near you. He will be glad to outline a plan for softening the water used in your condensers and engines.

PAIGE & JONES CHEMICAL CO., Inc.
General Sales Office, Technical Dept. & Works, HAMMOND, INDIANA
Executive Office: 461 FOURTH AVE., NEW YORK
Offices in Principal Cities

PAIGE-JONES
WATER SOFTENING

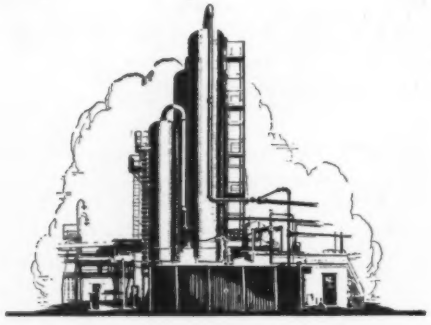
ZEOLITE AND LIME SODA SOFTENERS · PRESSURE SAND FILTERS
BOILER FEED WATER TREATMENTS · HOUSEHOLD WATER SOFTENERS

Mention Where You Saw the Advertisement

THE CROSS CRACKING PROCESS

CRACKING IN LIQUID PHASE
assures greater once-through yields

By maintaining the requisite pressure and temperature in the cracking chamber to hold the oil substantially in the liquid phase until the cracking reaction is completed, the CROSS PROCESS assures the greatest possible once-through conversion. Vaporization and its chilling or retarding effect is minimized.

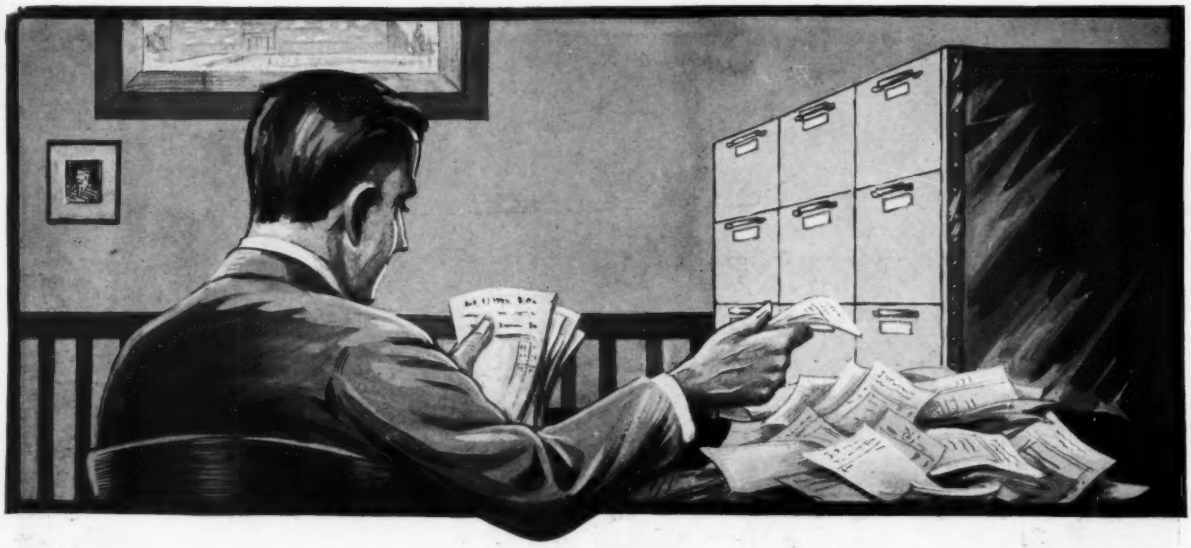


KELLOGG

CROSS CRACKING PLANTS—BUBBLE TOWERS—PIPE STILLS—HEAT EXCHANGERS—GRAY TREATING TOWERS—TREATING PLANTS

THE M. W. KELLOGG CO., 7 DEY STREET — NEW YORK

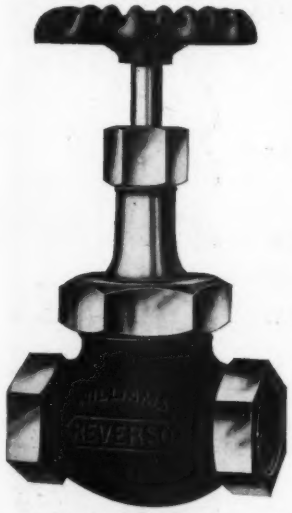
KANSAS CITY, MO., 700 BALTIMORE AVE. — SAN FRANCISCO, CAL., 444 MARKET ST., LOS ANGELES, CAL., 1019 HELLMAN BANK BLDG.



Throw out Repair Bills

Bills of that kind have one beneficial effect, at any rate. They make the shrewd executive think! From thinking to investigation is a short step. He wants to know the why—the reason for the bills. When found he can apply the brakes and stop them.

Ninety-nine times out of 100 the "why?" will be found in the valves. Originally these were chosen for their cheapness—the small initial outlay required for them.

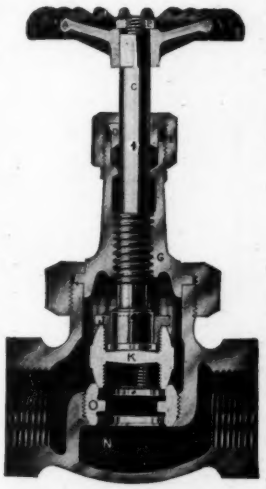


No. 780 REVERSO Valve
For 200 lbs. pressure and total temperature of 550° Fahr. A long lived valve which outlasts the ordinary valve on account of its higher seat vitality. Figured on the cost per year of leak tight service, it wins its way with the closest buyers. Reversible—Regrindable—Renewable, REVERSO has every element necessary to long life and low maintenance costs. Once in the line, the Reverso is there to stay—no more replacements or excessive upkeep expense—no wastage or production losses to drain away profits.
Order a sample from your dealer.

"Penny wise and pound foolish." Those cheap valves have proved terribly expensive. Under high pressures and temperatures they have collapsed and been repeatedly replaced. They have leaked and wasted steam steadily. They have caused numerous shutdowns and loss of production—to say nothing of much greater coal consumption.

The shrewd executive replaces his cheap valves with high-grade, and naturally chooses Williams Valves. He knows the Williams Company builds valves that last. That its product represents many years of experience in valve problems. That Williams Valves are dependable, durable and economical. That material and design qualify them for superior service. That they stop repair bills.

Abroad or at home—that is the story told of Williams Valves by all progressive plants. Why they have a world-wide reputation is described in our Catalogue 10. Write for a copy.



No. 780-S REVERSO Valve
Interior view of Reverso Valve. Note each detail—The wear-resisting, nickel alloy disc and seat—the reversible feature—the full free area—the union ring which secures hub to body and facilitates regrinding when necessary—the non-stripping stem which is gland packed and which is easily repacked under pressure when wide open. A non-heating wheel firmly lock-nutted to stem provides easy and comfortable operation.

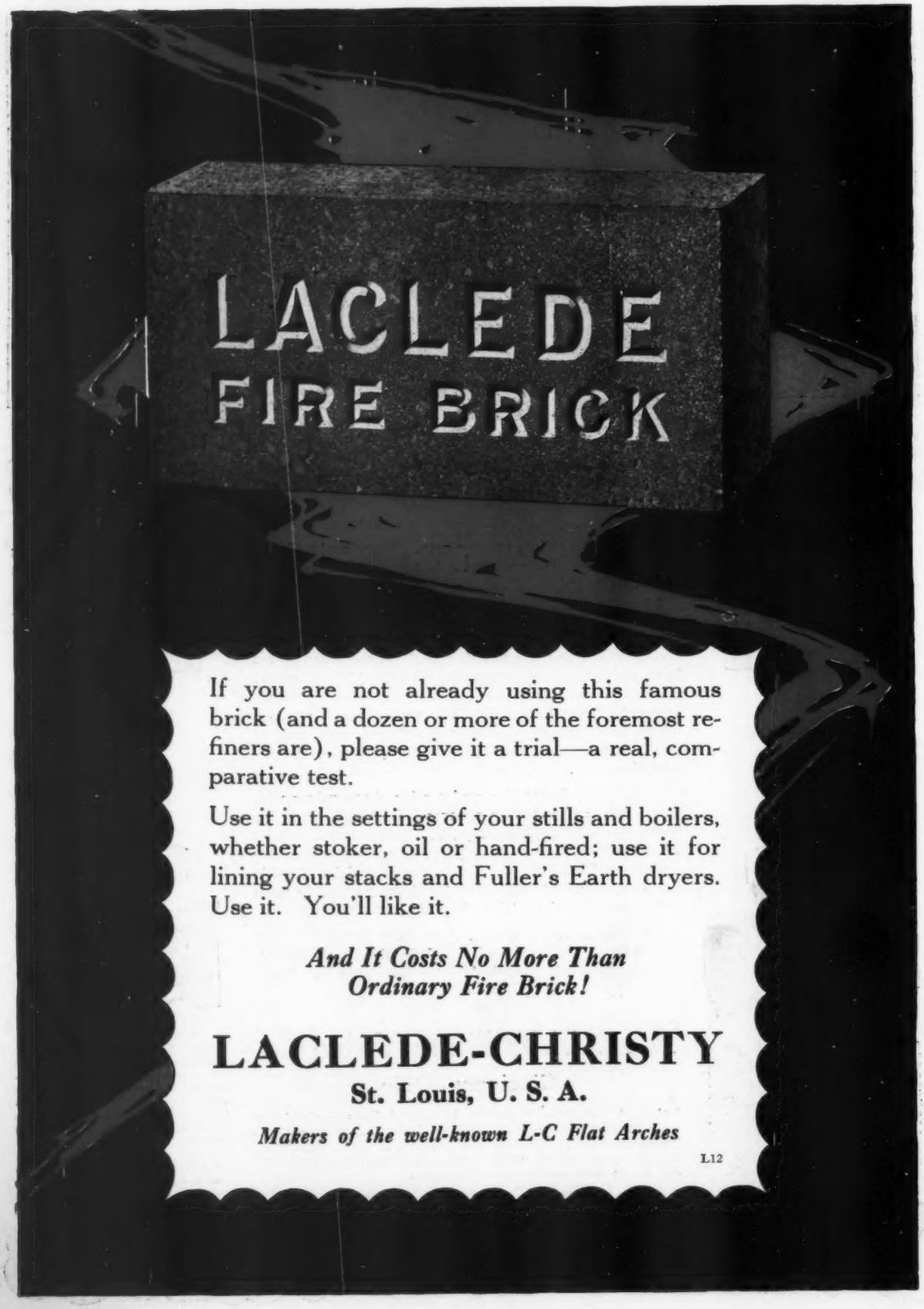
The D. T. Williams Valve Co.

Cincinnati, Ohio

Makers of High Grade Bronze and Iron, Regrinding and Nickel Seat Stop and Check Valves, Gate, Blowoff, Hydraulic, Swing and Ball Check, Needle, Hose, Whistle Valves, Stop and Air Cocks, Unions, Fittings, Water Gauges, Gauge Cocks, Oil Gauges, Lubricators, Oil and Grease Cups, Steam Traps, Separators.

Williams Valves

Mention Where You Saw the Advertisement



If you are not already using this famous brick (and a dozen or more of the foremost refiners are), please give it a trial—a real, comparative test.

Use it in the settings of your stills and boilers, whether stoker, oil or hand-fired; use it for lining your stacks and Fuller's Earth dryers. Use it. You'll like it.

And It Costs No More Than Ordinary Fire Brick!

LACLEDE-CHRISTY

St. Louis, U. S. A.

Makers of the well-known L-C Flat Arches

L12

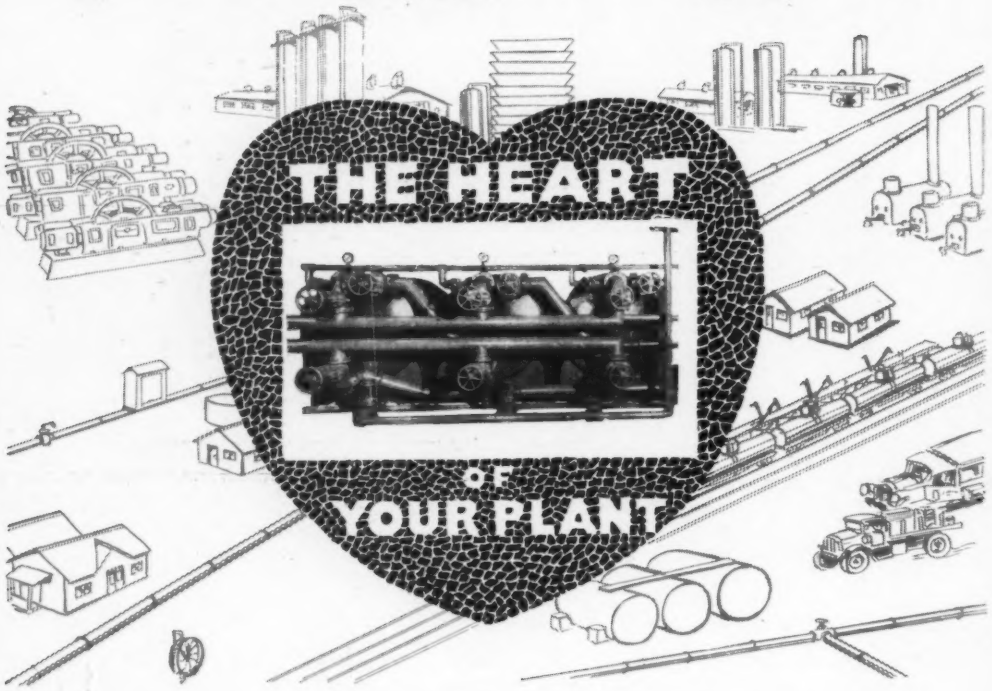
Mention Where You Saw the Advertisement

Let Cold Facts Safeguard
Your "Cold Cash"
WHEN you dig down into your treasury for a few thousand dollars (or a few hundred) to invest in gas compression—let the cold facts of proved performance safeguard this "cold cash" outlay.
What you expect is a cash return on your investment—compressor performance that will pay the highest dollar and cents interest by its low-cost output. You want (1) high mechanical efficiency, (2) high compression efficiency, (3) ruggedness to insure long, low cost service, (4) ready accessibility for adjustment or replacement to minimize idle time, (5) simplicity and (6) low operating and maintenance cost.
Bessemer compressors are outstanding in every one of these features, and a field survey of compressor performance will prove conclusively that Bessemers offer you greater dollar value, and greater protection for your compressor investment than any other units you can buy. Any Bessemer user will give you the facts you want. Ask him.
THE BESSEMER GAS ENGINE COMPANY
19 York Street
Grove City, Pa.
BESSEMER
BESSEMER OIL FIELD ENGINES—COMPRESSORS
VACUUM PUMPS—ROLLER PUMPING POWERS

Mention Where You Saw the Advertisement

CHARCOAL

Process of Gasoline Recovery



The *heart* of a natural gasoline plant — the plant proper — often represents less than *one-fifth of the total investment.* Yet the financial success of the plant is largely dependent on the efficiency of this unit.

That's why the heart of your plant should be the most efficient unit obtainable.

That's why it should be a Charcoal Plant

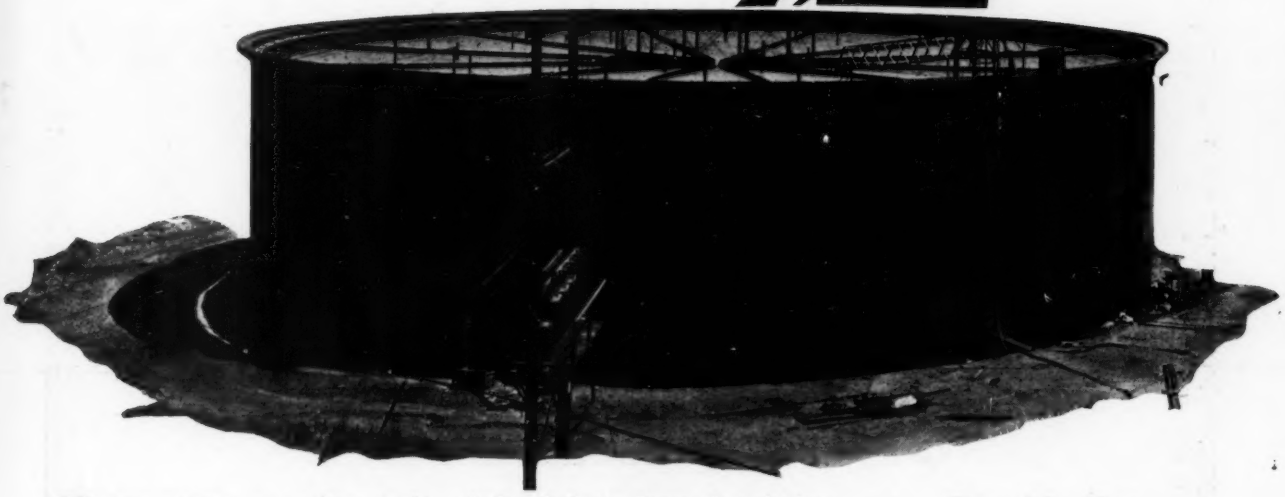
GASOLINE RECOVERY CORPORATION
CHARLESTON, W. VA.

TULSA
423 Wright Bldg.

LONG BEACH
Box 321

Mention Where You Saw the Advertisement

Guard your oil from evaporation and fire!



IF your storage or rundown tanks were being robbed of one barrel of oil out of every ten you handle, you would take some drastic steps to stop the loss. Even one barrel in a hundred or one in a thousand would call for some real protection.

But many refiners are being robbed of oil at a rate estimated by authorities to be fully as high as indicated above. The thief is "evaporation." Fences and police are powerless to stop this robbery.

Effective Protection

But a Wiggins Roof will guard your oil. It floats right on the surface of the oil, rising and falling as the tank is filled and emptied—never allowing any air space under the roof.

The Wiggins seal—the gastight connection between roof and tank—practically eliminates losses through thermal breathing and separates oil entrained in air bubbles. The gastight volume under this seal is less than 1% of that in a gastight roof for a 55,000-barrel tank and the thermal breathing loss is proportional to the proper volume. Air entering through the filling line loses its entrained oil under the seal and escapes to the atmosphere through a mercury sealed vent.

The roof shoes are so suspended that their weight normally throws them flat against the tank side. When passing over riveted seams, however, the shoe is momentarily held away from the tank. The oil surface thus exposed is very small and is at the bottom of a tall narrow slot. The heavy vapor forming on the surface of this oil is held down by gravity and further evaporation is prevented.

Proved by Tests

Repeated tests have demonstrated both the evaporation savings and the fire protection which are made possible by the Wiggins Roof. For example, one test on handling 320,000 barrels of a blend of crude oil and natural gasoline in tanks equipped with Wiggins Roofs showed a loss of only 4.6 barrels by evaporation. The oil company's own experience showed the same operation in gastight tanks would have meant a loss of 476.2 barrels, a net saving of 1.47 barrels per thousand barrels handled.

The most severe tests have demonstrated the inability of fire to reach oil protected by a Wiggins Roof. We will gladly send our new book, "Stopping Evaporation", in which these tests are fully described.

Ask our nearest office for a quotation on Wiggins Roofs to equip your tanks.

CHICAGO BRIDGE AND IRON WORKS

Chicago—2463 Old Colony Bldg.
New York—3102 Hudson Terminal Bldg.
Cleveland—2234 Union Trust Bldg.
Dallas—1655 Dallas National Bank Bldg.
Atlanta—1046 Healey Bldg.
San Francisco—1051 Rialto Bldg.

WIGGINS ROOF

Mention Where You Saw the Advertisement

There's a sun tax on every un-insulated tank

Insulate storage tanks against the sun's heat and you greatly reduce breathing losses.

Make deck and eaves vapor-tight and you eliminate wind drift.

Johns-Manville Vapor Tight Insulated Tank Tops* do both. They save a lot of money.

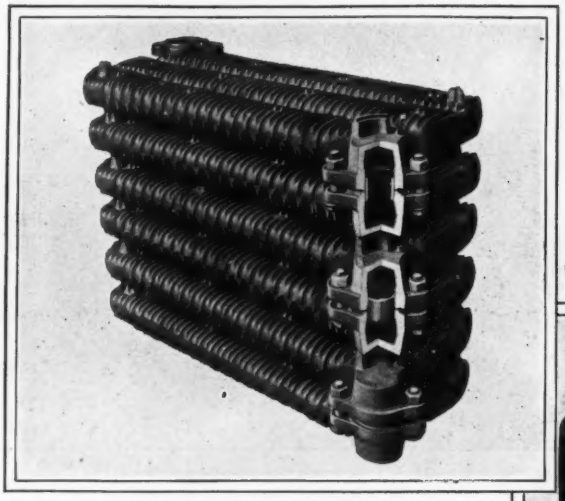
**Patented—other patents penaing*

Three Johns-Manville Vapor Tight Insulated Tank Tops at Mers-el-Kebir in Africa, where you know the sun is HOT.

JOHNS-MANVILLE
Oil Industry Department

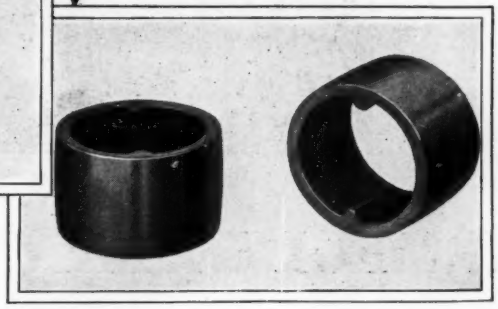
JOHNS-MANVILLE CORPORATION, 292 MADISON AVENUE AT 41ST STREET, NEW YORK CITY
BRANCHES IN ALL LARGE CITIES. FOR CANADA: CANADIAN JOHNS-MANVILLE CO., LTD., TORONTO

STERLING



Stack of STERLING Oil Condensing Sections. Cut-open view to show new Ground Joint. Supplies the Petroleum Industry with rugged construction and *tight* joints, under high pressures and temperatures.

New Ground Joint Nipple is lathe-turned to the arc of a true circle, thereby adjusting itself accurately to any cocking or inaccurate assembling. Both Nipples and Sections are made of ARCO Metal (corrosion-resisting), hence joint is not affected by expansion or contraction. Will remain *permanently* tight.



Announcing—

The *New* Ground Joint on STERLING Sections and Accessories

Made of ARCO Metal

Changes in Distillation practice, necessitating higher pressures and temperatures, are now fully met by us in these re-designed STERLING Sections and Accessories with Ground Joints.

The new Ground Joint, with its accurately crowned or arc-formed surface, will stand as great pressures as the Sections—which guarantees against leakages. Further, it has been demonstrated that the new Ground Joint facilitates installations, with ordinary labor. Less than half the time is required to erect these Sections with Ground Joints.

Although the extra equipment and processes employed in producing these Nipples and the fine machining of Sections entail greater investment and expense on our part, no extra charge will be made therefor.

Under test at one of the country's largest Refineries, the Ground Joints held without leaks or sweating under 150 lbs. cold water pressure for 24 hours. After operating at this Refinery under conditions which caused the assembled Sections and Accessories to reach a temperature of more than 500 degrees, F., the Sections and Ground Joints held against a test pressure of over 500 lbs. (cold water).

STERLING Oil Sections with Ground Joints are already being used successfully, in several notable installations, on higher temperatures and pressures than was possible with the former Joints.

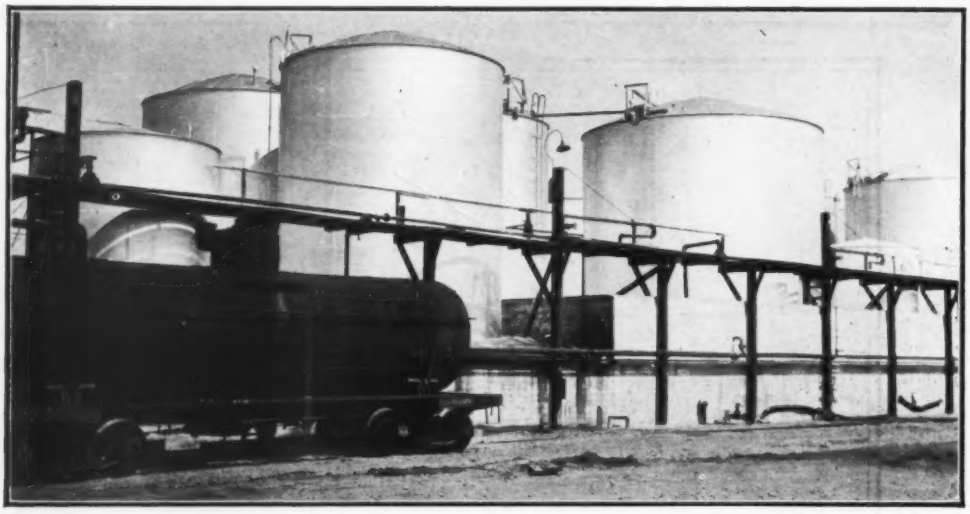
* * *

A New Catalogue on the STERLING Ground Metal Joint will be mailed free on request.

AMERICAN RADIATOR COMPANY

Industrial Division No. D

40 West 40th Street NEW YORK — 816 South Michigan Avenue CHICAGO — 935 Kennedy Bldg. TULSA — 1214 Quinby Bldg. LOS ANGELES



California Petroleum Corporation Gasoline Tanks Coated with Bitulumin

HARMFUL ULTRA VIOLET RAYS
have slight effect
ON ALUMINUM PAINTS

BITULUMIN Largely Immune. Deflects 86% of Destructive Light Rays. Outlasts Lead and Zinc Paints Two to One.

A correctly made aluminum paint like Bitulumin will outlast any lead and zinc paint on exposed surfaces by two to one. This is because of Bitulumin's peculiar "weather" resisting qualities. Paint's worst enemy is the sun, whose destructive Ultra Violet rays break down paint surface allowing moisture to penetrate.

Bitulumin is largely immune to this attack because it offers to the sun's rays an aluminum armor which turns away 86% of them.

In turning back destructive light and heat rays Bitulumin makes a cooler surface and in the case of tanks reduces evaporation.

Bitulumin, while extremely popular for painting oil storage, is not limited to that field. It is a many purpose paint and has demonstrated its unusual qualities for painting tanks, tank cars, refinery equipment, metal buildings and roofs, smoke stacks, steel bridges and many others.

Bitulumin, put up in double containers to insure fresh mixing, is manufactured by Hill, Hubbell & Company, manufacturers of a special line of paints for the oil industry.

HILL, HUBBELL & COMPANY

Manufacturers of
Highest Grade Oil Industry Paints and Pipe Line Coatings
Factories at SAN FRANCISCO and TULSA

District Offices:

331 W. Eleventh St., LOS ANGELES
2412 First Ave. S., SEATTLE
1006 Washington Ave., HOUSTON
51 First St., PORTLAND
15 Moore St. NEW YORK CITY
600 E. Lombard St., BALTIMORE

Mention Where You Saw the Advertisement

JENKINS CRACKING PROCESS

PRODUCES QUALITY GASOLINE

Facts from performance

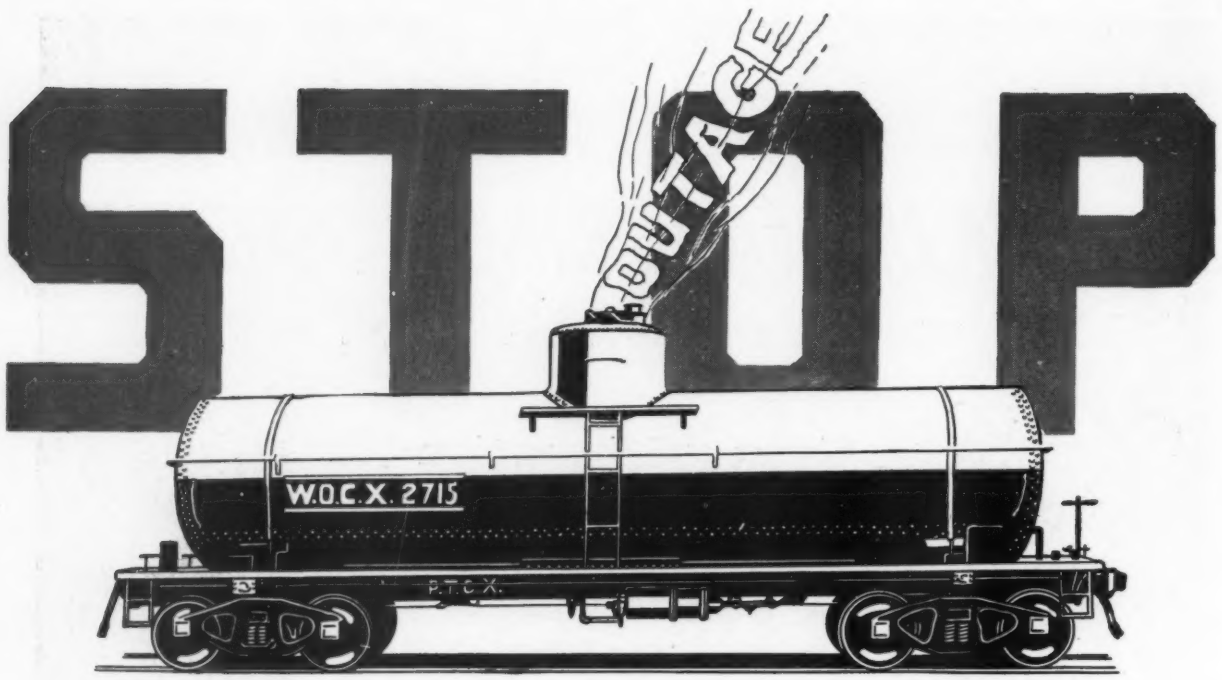
Even with nation-wide gasoline surplus and prices at or below ordinary costs, Jenkins Licensees readily dispose of their output advantageously.

The high quality product and operating economy have made this possible.

GRAVER *Founded 1857 Corporation*

EAST CHICAGO, INDIANA

NEW YORK Grand Cent. Term. | CHICAGO America Fore Bldg. | TULSA Atlas Life Bldg. | HOUSTON West Building



Evaporation losses in your shipped product can be stopped by making a *low vapor pressure, high recovery* product with a NEWTON Distillation Unit.

Producer's Problem

Loaded tank car 10,000 gal.
Same car unloaded at destination . . . 9,000 gal.
Outage deducted 1,000 gal.
Loss taken on the manufacture of . . . 1,000 gal.
Loss taken on freight paid on . . . . 1,000 gal.
Loss of profit on 1,000 gallons because it could not be sold. And all because the original product could not withstand shipment on account of vapor pressure. NEWTON Equipment will cut your losses to the minimum.

¶ NEWTON Blending Evaporators and Fractionators hold as a desirable product the most that absorbers can extract from gas. ¶ The saving effected will soon pay for the installation. ¶ This will surely interest you as a producer of natural gasoline. ¶ Ask for complete details.

NEWTON PROCESS MFG. CO.

FULLERTON *(near Los Angeles)* CALIFORNIA

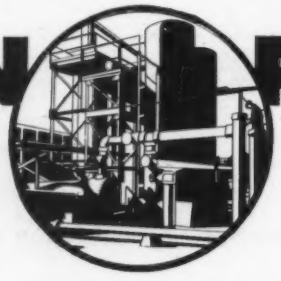
Hurley Brothers
Kennedy Bldg.
Tulsa, Oklahoma

The National Supply Company
General Offices:
Toledo, Ohio

Foreign: The National Supply Corp.
120 Bdwy., New York

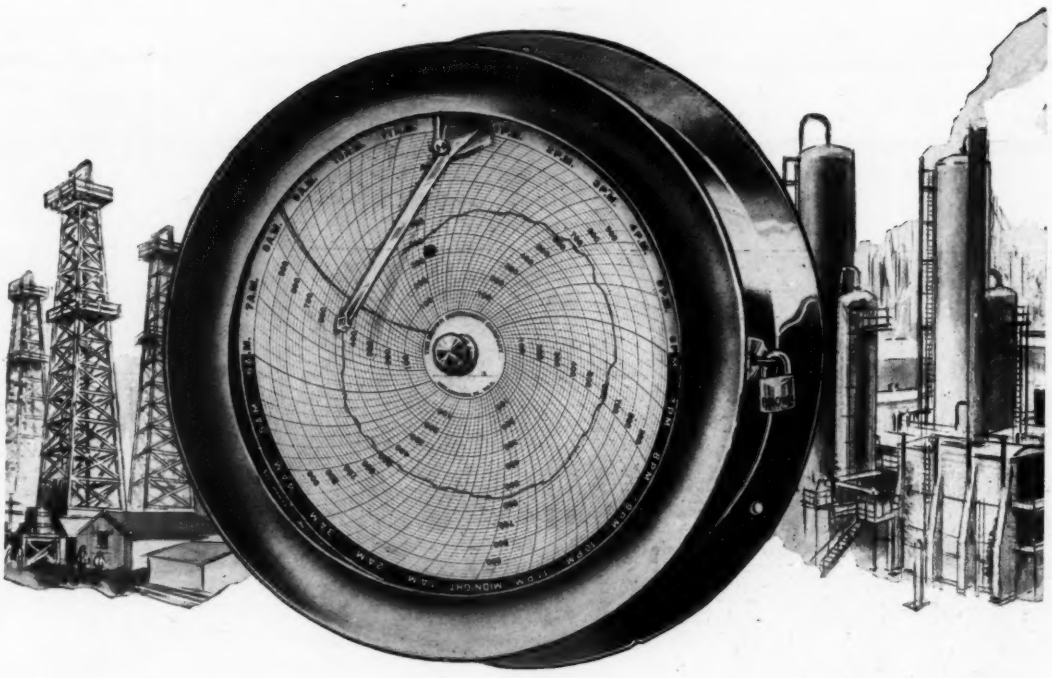
NEWTON PROCESS

Known far and wide as



the "Profit Process"

Mention Where You Saw the Advertisement



Pressure May "Make or Break"

At the Well
At the Pipe Line
At the Still
At the Boiler

Air or gas pressure at the well,

Oil or gas pressure at the pipe line,

Vapor pressure at the still,

Steam pressure on boiler and line—

Everywhere—PRESSURE may make or break profits.

Brown indicating, recording, signalling and controlling pressure gauges, installed at every point where pressure exists, assure an accurate and continuously dependable check on this critical factor.

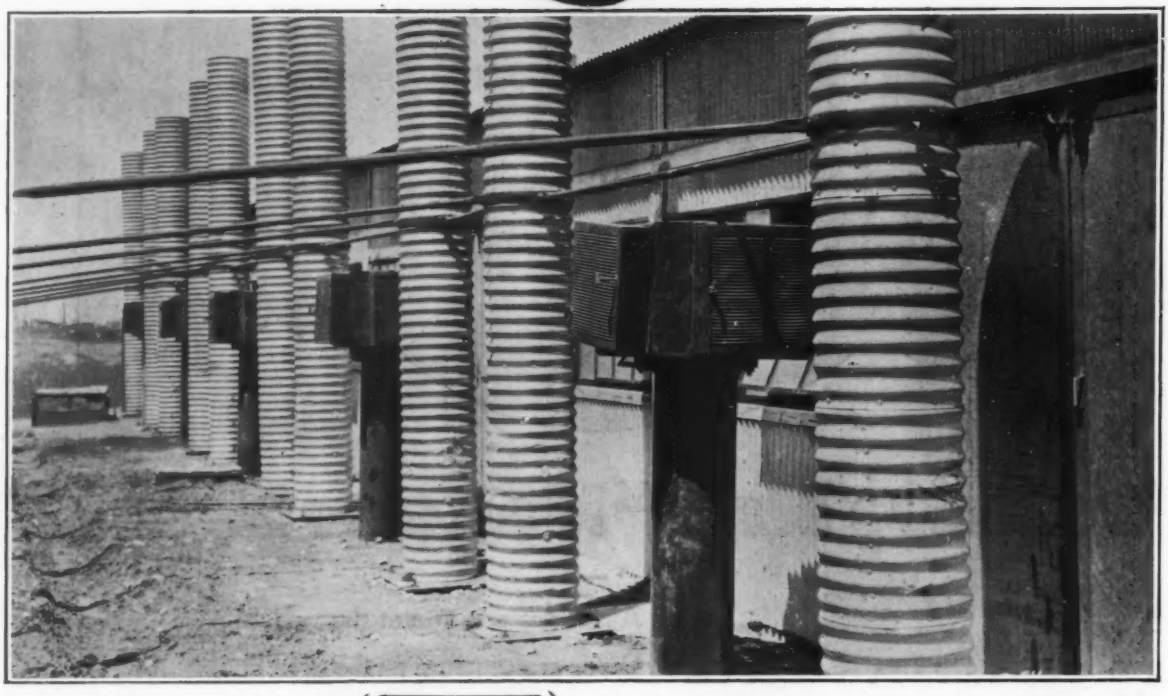
A complete line of "distant reading" and other types. Circular-chart or strip-chart recorders. Ask for free catalog No. 75. THE BROWN INSTRUMENT CO., 4413 Wayne Ave., PHILADELPHIA, PA. Branch offices in 18 principal cities.

Pyrometers
Automatic Temperature and Pressure Controls
Flow Meters
Recorders
CO_2 Meters
Pressure Gauges
Vacuum Gauges
Liquid Level Gauges
Draft Gauges
Thermometers
Tachometers
Hygrometers

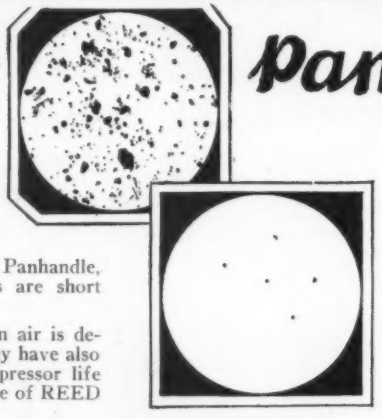
Brown Pressure Gauges

"To Measure is to Economize"—*Pascal.*

REED AIR IS CLEAN AIR



Panning Panhandle Air



THE MICROGRAPH on the left shows the dust content of ordinary air. The micrograph at the right shows the result after this air has passed through a Reed Air Filter. Over 97% of the dust, soot and grit has been removed.

Out on the wind-blown plains of the Panhandle, unprotected engines and compressors are short lived.

Operators have learned that dust-laden air is destructive to compressor efficiency. They have also learned that efficient engine and compressor life may be materially lengthened by the use of REED AIR FILTERS on every air intake.

Engines and compressors that formerly were shut down frequently for repairs—for the renewing of bearings and other parts—today are still running, trouble free, over long periods of time—protected by REED AIR FILTERS.

The photo shows a picture of compressors protected from dust-laden Panhandle air by the use of REED AIR FILTERS. It's just one of many installations by one of the leading operators.

REED AIR FILTER CO., INC., LOUISVILLE, KY.

Texas Offices:
924 Post Dispatch Bldg., Houston, Texas
1402 Fort Worth National Bank Bldg. Fort Worth, Texas

Distributed to the Oil Industry by
SMITH SEPARATOR COMPANY
Tulsa Okla.

California Office:
2039 East 38th St., Los Angeles, Calif.

Louisiana Office:
405 Forest Ave., Shreveport, La.

Guard Against Costly Shut-Downs

Every refiner realizes the advantage in his production if he can operate for a considerable time without any shut-down for repairs. Too often shut-downs, resulting in costly loss of production, are due to short-sighted economy in the purchase of inferior materials.

Pittsburgh Seamless Steel Boiler Tubes and Still Tubes

are manufactured from the finest basic open hearth steel and provide the best insurance against shut-downs for repairs to boilers and stills. They are made by piercing solid steel billets, which proves the soundness of every foot of finished tubing, and our rigid inspection insures uniformity in both chemical and physical properties.

Pittsburgh Seamless Steel Tubes are giving eminent satisfaction in the oil industry. "Pittsburgh Seamless" quality is now available not only as boiler tubes and still tubes, but for drill pipe, oil well tubing, and seamless casing in all sizes up to 14 inches in diameter. Warehouse stocks at convenient points insure good delivery service.

Inquiries will be given prompt attention.

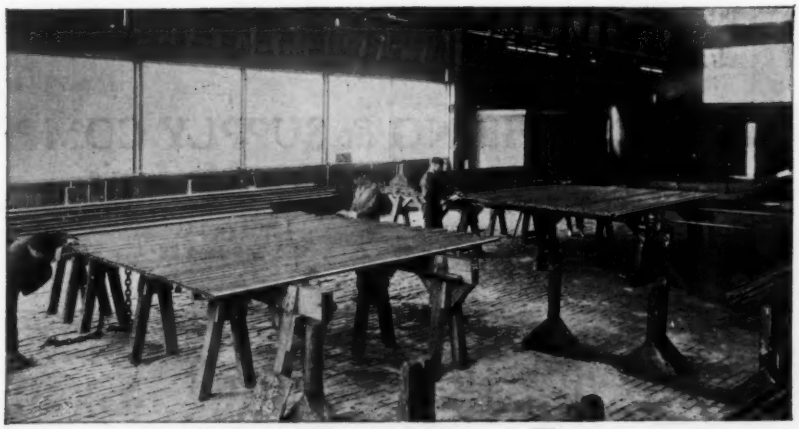
Pittsburgh Steel Products Co.

Pittsburgh, Pa.

NEW YORK
Second National Bank Bldg.
Houston, Texas

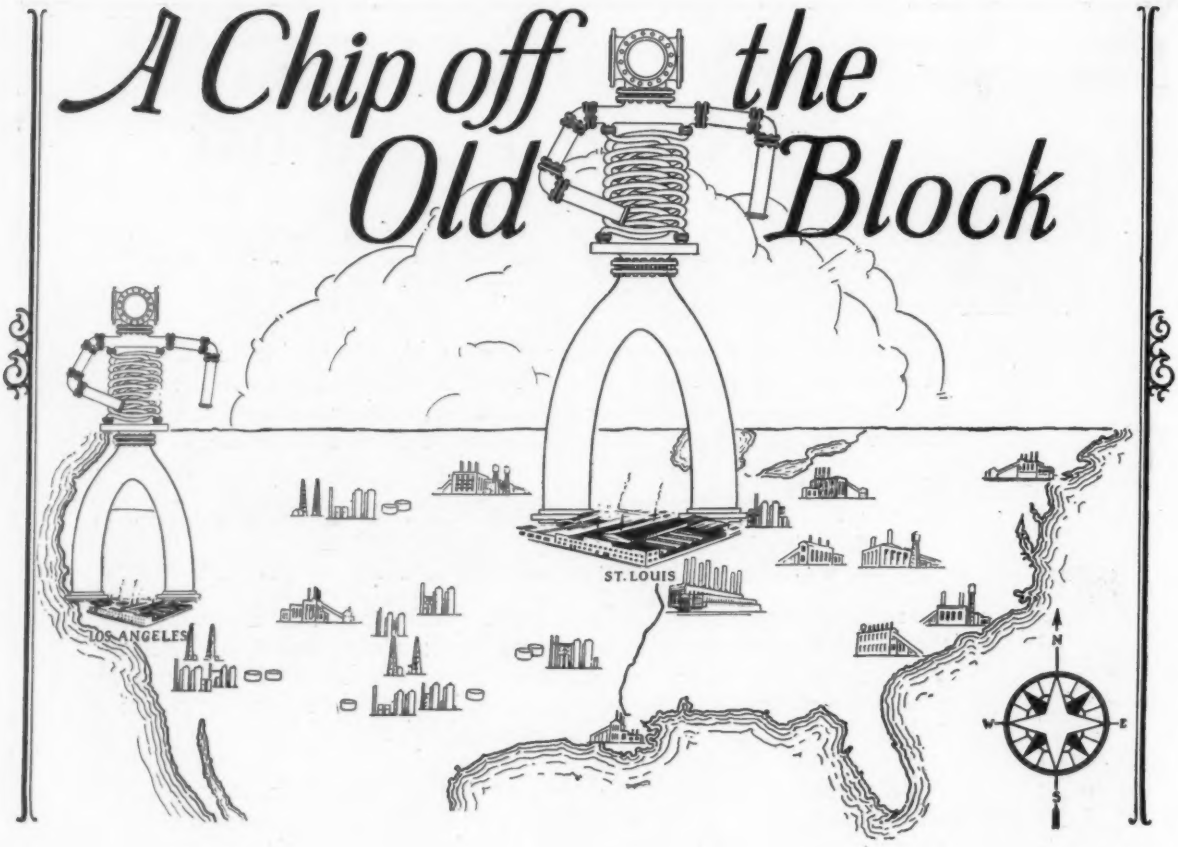
DETROIT

CHICAGO
Atlas Life Bldg.
Tulsa, Okla.



Inspecting Seamless Tubes

A Chip off the Old Block



THE pipe fabricating shop and warehouse that Midwest has established in Los Angeles can probably best be described by the old saw that is our headline. Like the parent plant in St. Louis, this shop is prepared to fabricate either a simple coil or bend, or complete piping for oil refinery or modern power plant. And the warehouse has a large stock of pipe, flanges and fittings for prompt shipment.

Los Angeles is employing the same efficient methods and equipment used in the St. Louis plant. The coast plant is in charge of men trained at St. Louis—in an organization that has contributed much to the development of high pressure and high temperature piping.

This Los Angeles plant is not a new project but simply a chip off an established concern that is enjoying a high reputation for the quality of its product—its ability to make delivery—and competent engineering counsel when it is desired.

Bulletin P-2 will tell you more about Midwest Piping Service on the Pacific Coast.

MIDWEST PIPING & SUPPLY COMPANY

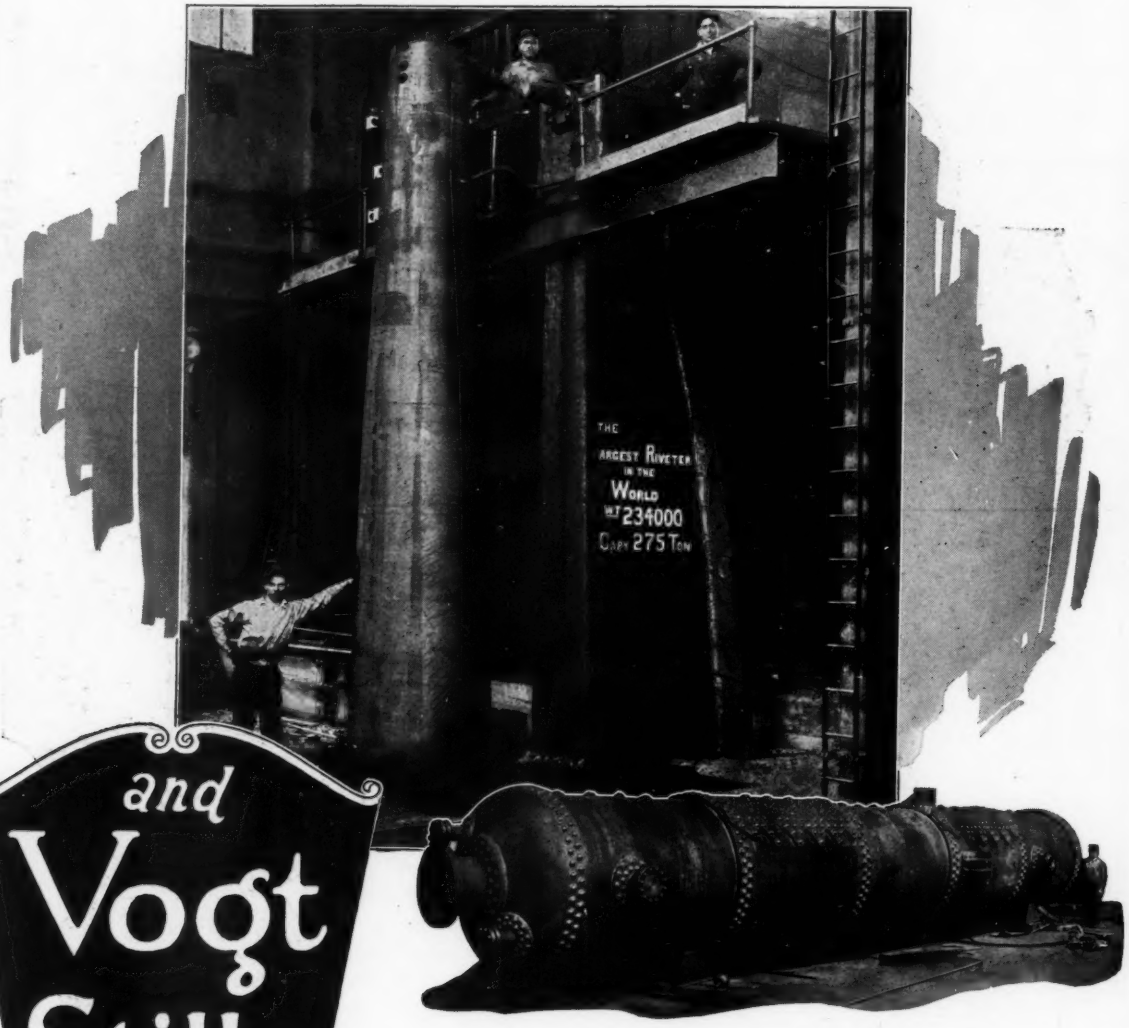
Plants at Los Angeles and St. Louis

Offices:

LOS ANGELES,	TULSA,	ST. LOUIS,	CHICAGO,
520 Anderson St.	805 Mayo Bldg.	1450 S. Second St.	208 S. La Salle St.

MIDWEST Piping Service

The World's Largest Riveter



and Vogt Stills

TO maintain leadership and continue to set the pace in design and construction of heavy plate riveted stills and similar equipment, it became necessary to add this largest of hydraulic riveters to Vogt Shop equipment.

HENRY VOGT MACHINE CO.
INCORPORATED
LOUISVILLE, KY.

Manufacturers of: Oil Refinery Equipment, Drop Forged Steel Valves and Fittings, Water Tube and Horizontal Return Tubular Boilers, Ice Making and Refrigerating Machinery.

BRANCH OFFICES:
NEW YORK
CHICAGO
CLEVELAND
DALLAS
PHILADELPHIA

Mention Where You Saw the Advertisement

REID RECEIVING BOXES

For sampling, cutting and distributing the oil as it comes from the stills.

Special patterns and designs made to your specifications.

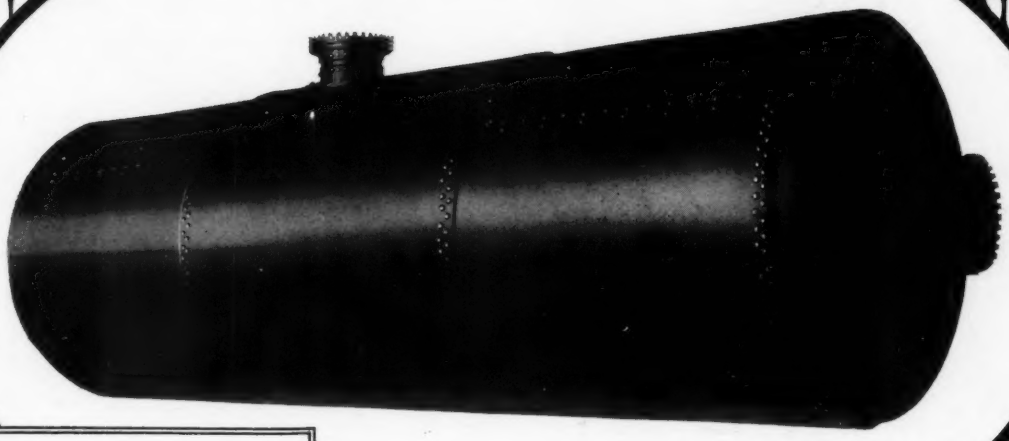
Write for Bulletin No. 30

Joseph Reid Gas Engine Company
Oil City, Pennsylvania, U. S. A.

Western Representative: Frick-Reid Supply Co., Tulsa, Okla.
Export Representative: Oil Field Equipment Co., Inc., 30 Church Street, New York City, U. S. A.

REID REFINERY EQUIPMENT

STRUTHERS-WELLS Steel Plate Construction



Special Type High Pressure Cracking Still of Struthers-Wells construction — made for large Mid-Continent refiner.

257 of These Stills Now in Use

Six years ago one of the largest Mid-Continent refiners placed an order with us for a special type still, as shown in the illustration. Since that time, orders for 257 of these stills have been received and you will find them giving the very best of service in all the large refineries of this company.

That surely is significant evidence of the dependability and satisfaction of Struthers-Wells products.

Operating the largest electric welding plant in the country it is possible for us to manufacture pressure and vacuum stills of welded or riveted construction. Send us your specifications.

FOUNDERS—MACHINISTS
BUILDERS OF SPECIAL MACHINERY

STRUTHERS-WELLS PRODUCTS FOR REFINERIES

Bubble Towers
Heat Exchangers
Dephlegmators
Condensers
Distillate Separators
Grease Mixing Kettles

STRUTHERS-WELLS CO

WARREN, PENNA.

MANUFACTURERS — ENGINEERS

Seventy-Five Years of Accumulated Experience at your Service.

Steel Plate Construction

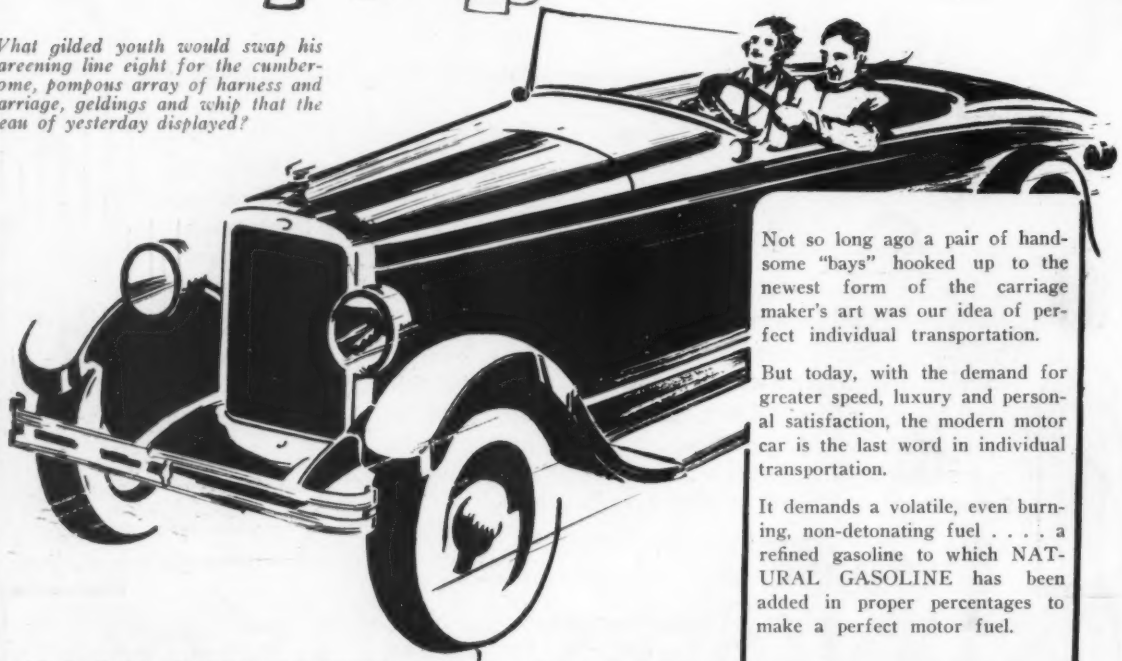
CHEMICAL — REFINING — RUBBER

Branch offices in principal cities

"Anything in Plate construction of Stainless Steel."

TRANSMIGRATION of TRANSPORTATION

What gilded youth would swap his careening line eight for the cumbersome, pompous array of harness and carriage, geldings and whip that the beau of yesterday displayed?



Not so long ago a pair of handsome "bays" hooked up to the newest form of the carriage maker's art was our idea of perfect individual transportation.

But today, with the demand for greater speed, luxury and personal satisfaction, the modern motor car is the last word in individual transportation.

It demands a volatile, even burning, non-detonating fuel . . . . a refined gasoline to which NATURAL GASOLINE has been added in proper percentages to make a perfect motor fuel.

CHESTNUT & SMITH
CORPORATION
Tulsa, Oklahoma

A DEPENDABLE SOURCE OF YOUR SUPPLY OF NATURAL GASOLINE

Vol. 6, No. 7

JULY, 1927

The REFINER

AND NATURAL GASOLINE MANUFACTURER

Edited Monthly at Tulsa, Oklahoma

GRADY TRIPLETT, *Editor*

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WHY THE SEVEN O'CLOCK GAUGE 122

Published Monthly by GULF PUBLISHING COMPANY
Copyrighted, 1927

R. L. DUDLEY, *President* — A. L. BURNS, *General Manager* — SPENCER W. ROBINSON, *Editorial Director* — J. KENT RIDLEY, *Managing Editor*

Editorial Office: 214-218 Atco Building, Tulsa, Oklahoma

Office of Publication: 1716 Dallas Avenue, Houston, Texas

NEW YORK: Room 832, 250 Park Avenue, R. P. Swinsky, Manager. *PITTSBURGH*: 510 Park Bldg., W. W. Pigue, Manager. *CHICAGO*: 476 First National Bank Bldg., O. R. Waller, Manager. *LOS ANGELES*: 1201 Haas Bldg., Wm. V. Gross, Manager. *TULSA*: 214-218 Atco Bldg., J. F. Carter, Jr., Manager. *FORT WORTH*: 203 W. T. Waggoner Bldg., H. H. King, Manager. Single copies 20 cents. Domestic Subscription price, $1.00 a year. Foreign Subscription price $1.50 a year. Advertising rates upon application.

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EDITORIAL COMMENT

Houston and the A. P. I.

The American Petroleum Institute has held meetings in six different cities since it was first organized, one in Washington, one in Chicago, two in St. Louis, one in Ft. Worth, one in Los Angeles, one in Tulsa and now it is going back to Chicago.

Why not hold the 1928 meeting in Houston?

Houston has ample hotel facilities to handle the crowd —Houston hotels have ample facilities for committee meetings. In fact, Houston's facilities for holding the A. P. I. will rank well with those of any city which has hitherto been host to the Institute.

We believe that the American Petroleum Institute should recognize Houston's claim—which is even more than a claim—it is an obligation.

* * *

Spain expropriates the properties of Americans along with those of its own nationals in establishing its oil monopoly. Remembering Mexico and rumors from South America, one word all oil operators should know in Spanish is "Ouch!"

* * *

Statistically there is some encouragement in the circumstance that all this flood of oil is being produced with less drilling, which tends to bear out the tempering of the wind to the shorn lambs. But the trouble seems to be that the tempered winds are not fanning the right lambs.

* * *

Production records have been broken so frequently in recent weeks that such an event no longer has news value, but the situation is one that certainly exercises the imaginations of those fellows who are guessing when to buy oil stocks that will go up when production goes down.

* * *

South American countries have construed utterances of the oil board as meaning that Americans propose to secure all the oil deposits there, and are moving to nationalize such minerals a la Mexico. At least the board has secured one result.

* * *

Sir Henri Detering assures us that we need not fear synthetic motor fuel produced by the dye makers in Germany. Mortuary reports indicate that few Americans fear anything synthetic.

* * *

Every gas line built in the Southwest means just that much less demand for fuel oil in industrial plants. Perhaps losing this market will goad the oil industry to finding additional outlet which will extend to even broader use of this fuel.

OUR good friend Arthur Knapp, with his penchant for parable, Queen Elizabeth's yew trees and other fairy stories, now has the oil business on the hog—or at least it appears so by inference, in the following observation on the current situation:

"Once upon a time, there were some farmers who had a nice market for shoats. (Definition: shoat—little pig.) They could sell all of the shcats which they could raise and at a good profit, too. However, these farmers were not satisfied to stay home and mind their own shoat business. No! They had to get out and visit all the neighbors. They had to find out how many hogs the other fellow was raising, how much they got for them, how much it cost to feed them, and so on, infinitum. In fact, they spent more time in the other fellow's hog pen than they did in their own.

"What happened? First thing you know, there was a contest on to see who could raise the most and biggest hogs.

"Now, the fellow who was buying shoats, had no particular use for big hogs, so there the farmers were, with a lot of nice fat hogs on their hands which they could not sell.

"Substitute oil man for farmer and you have the present situation and a number of similar and past situations, right in a nut shell.

"The trouble is not too much competition, but too much wondering how to beat the other fellow. If each oil company would produce or buy just enough crude to make such refined products as it was SURE it could sell, then the oil situation would be quite different.

"Of course reserves are essential, but in the form of hog food and not hogs.

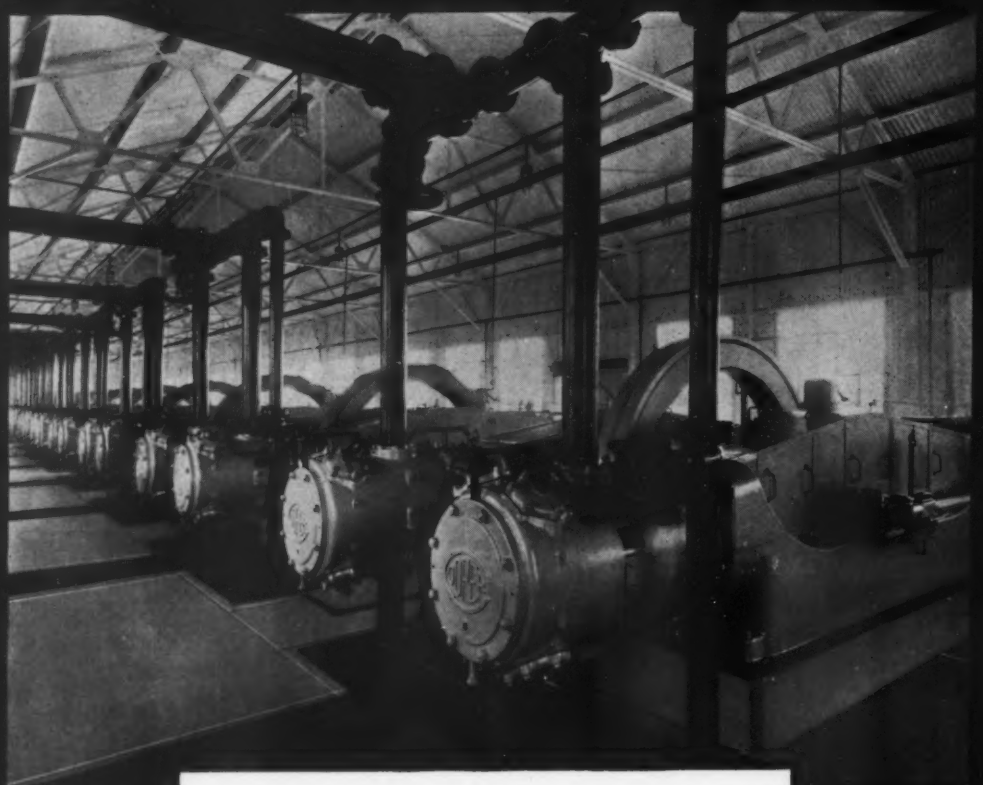
"This suggestion may appear obvious, but HAS IT EVER BEEN TRIED?"

What About Fuel Oil?

A review of the fuel oil consumption in, for instance, the electric power plants on the Eastern Seaboard shows a loss.

Due to reasons which may or may not be good, apparently the industry has not been as concerned about the sale of fuel oil during the last few years as it formerly was. No doubt, many leaders of the industry have felt that it is an economic waste to burn oil as fuel, and many of them have been afraid to make contracts over a considerable period.

But if we had a material consumption of fuel oil right now, it would be a most satisfactory outlet! And possibly of less economic wastefulness than an overproduction of crude with nowhere to put it!



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Blending of Distillates and Natural Gas Condensates

By GEORGE REID
Staff Representative

BLENDING of petroleum distillates and natural gas condensates, both for the purpose of raising gravity of certain refined products converting them into valuable motor fuels, and for the purpose of lowering vapor pressure and increasing recovery of light natural gasolines, making such a product more stable and less liable to excessive evaporation and handling losses, constitutes one problem to which refiners and natural gasoline manufacturers have given much study during the past few years.

Refiners have reduced their blending problems to one of simplicity, and through judicious mixing of distillates and condensates, while cold and in the liquid state, have found that blending natural gasoline with refiners' naphthas, etc., is governed by a few simple rules, and that gravities and initial boiling points, and in some instances, final boiling points, are easily obtained by proper mechanical mixing of the physically and chemically kindred distillates. Blend formula are universal knowledge at present, whereas, a few years ago several refining companies are known to have paid "expert blenders" for the "secret" formula of mere cold mixing, and which subject was taught as one of the mysteries of the trade and imparted to only certain key men within the company,—at $100.00 per man. The refiner now uses vast quantities of natural gasoline for the purpose of providing volatility, to raise gravity, lower initial boiling temperatures and to effect slight reduction of end points to the end that virtually all of our present day commercial gasoline is a blended product. Such practice carries with it the additional advantage of permitting the refiner to cut more deeply into his crude, thus effecting a slightly grater percentage recovery of gasoline from the barrel of crude.

Reducing Vapor Pressure

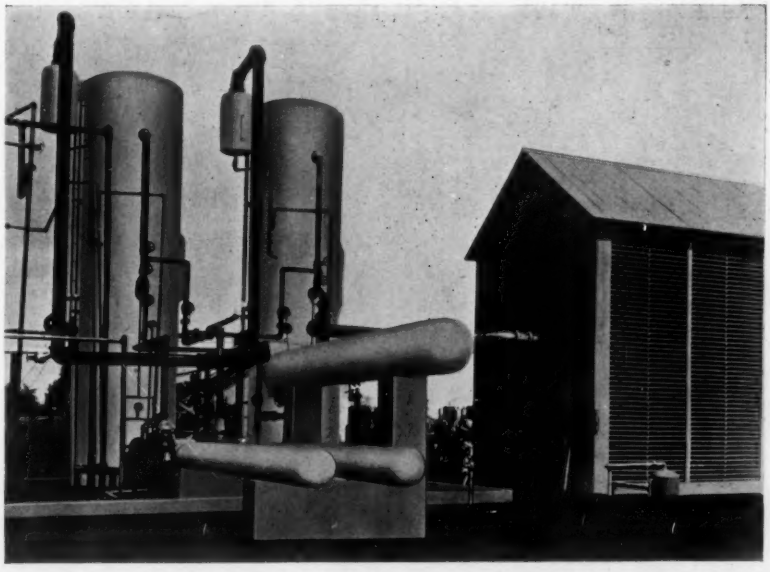
Another phase of blending which has been attracting considerable attention from both the refiner and the manufacturer of natural gasoline, is that of employing small quantities of the refiners' naphtha for use in intermixture with very light and volatile natural gasolines for the purpose of lowering vapor tension or pressure of the natural gas condensate.

The fact has been known that small quantities of naphtha when mixed with natural gasoline in cold blending practice would effect an appreciable lowering of vapor pressure and a slight increase in distillation recovery. To accomplish material results however, by cold blending, it has been found that when sufficient naphtha is ued to reduce vapor pressure, and to improve distillation recovery to meet such a specification as 90 per cent recovery, that the quantity of naphtha necessary is so large that end points are raised prohibitively, and the physical properties of the resultant mixture become such that the blend can no longer be classified as natural gasoline. To overcome these obstacles of cold blending of distillates, there has recently been perfected a blending system which employs heat as a principal factor contributing to its success, and which effects the use of small quantities of naphtha to accomplished results in gravity and vapor pressure reduction, along with increased recovery and very little increase in end point specifications, which is of much interest. In this heat treatment procedure, or what might be termed, semi-vapor phase blending, very small percentages of naphtha are used to accomplish results, which in cold blending practices would require many times the volume of naphtha distillates as are employed and producing a natural gasoline of very high recovery, low evaporation losses and otherwise markedly stable.

Hot Blending System

At the Bakers Lane and Vincennes plants of the Ohio Oil Company, Illinois, Hurley Brothers, Mid-Continent representatives for the Newton Process Company, have been experimenting for the past several months with a new system of blending, and have perfected an apparatus for this work which is to be called the Newton Process Blending Evaporator System. Working in cooperation with the engineering department of the Ohio Oil Company, the new system has been subjected to a comprehensive series of experiments, all for the purpose of confirming or negating the apparent advantages of the hot blending apparatus.

The natural gasoline produced in this district by the compression type of gasoline plant, of which there are quite a number, is very "wild", or of high volatility. The specifications on this product usually are about 90 degrees A. P. I. gravity, 50 degrees Fah., initial boiling point, with and end point of 235 degrees Fah. Distillation recovery averaged around 78 per cent. With several compression plants operating in a given field al producing such a product as just described, it becomes necessary to take steps toward overcoming the "wildness" of the product in order to make it salable. Cold blending with small proportions of refiners naphtha had been worked with, but not successfully, for obvious reasons. The next step would involve replacing present plant equipment with other types of plants, or produce a stable blend which would meet the buyer's requirements. Hot



EVAPORATOR INSTALLATION FOR SEMI-VAPOR PHASE BLENDING, OHIO OIL COMPANY, BAKERS LANE, ILLINOIS.

blending, or semi-vapor state blending being the most economical way out, the Newton process engineers were called in and the apparatus as illustrated was perfected.

Principally, what this type of plant does in one installation, is to blend the very light natural gasoline with but a small amount of naphtha, while the natural gasoline is in its vapor state and while the naphtha is very hot. The natural gasoline when it enters the apparatus has the specifications as given above, which are given again here for ease of comparison:

Specifications

Gravity—90.7 degrees A. P. I.; Initial Boiling Point— 50 degrees F.; End Point —235 degrees F.; Recovery, 78 per cent.

The blended gasoline leaves the apparatus and is conducted to storage, after cooling and condensation, with the following specifications:

Gravity—77. degrees A. P. I.; Initial Boiling Point—72 degrees F.; End Point —368 degrees F.; Recovery— 90-93 per cent.

In preparing the above described blended natural gasoline there was a total of only 10 per cent of 52.1 degrees A. P. I. naphtha used. The specifications of the naphtha are, 52.1 degrees A. P. I. gravity; 200 degrees F. Initial boiling point, and 400 degrees F. End Point. This was a specially prepared naphtha, others were not. In this blend however, the 10 per cent of naphtha when blended under heat and low pressure with 90 per cent of 90 degrees A. P. I. gravity, produced a blend having a gravity of 77 degrees A. P. I. gravity—and having the other specifications as outlined in the preceding paragraph. According to cold blending formula, the mixture of 10 per cent of such naphtha with 90 per cent of natural gasoline of such a type, would result in a finished blend having a gravity of 86.8 degrees A. P. I. In fact the resultant blend was much lower in gravity, being 77 degrees A. P. I. Putting it differently, according to our established formuli for cold mixing, it would require 34.5 per cent of 52.1 A. P. I. gravity naphtha to reduce the gravity of 90.7 degrees A. P. I. gravity natural gasoline to the gravity of 77 degrees A. P. I. This under cold blending methods. By heat and low pressure the quantity of naphtha required to accomplish the results as given is about one third.

Results

Considering the results of some other experiments along these lines the following information is of interest.

Naphtha -258 initial; 436 end point; 48-50 gravity.

Raw Gasoline—63 initial; 360 end point; 76.8 degrees gravity; 64 per cent recovery.

Finished, blended product—70 degrees F. initial; 398 degrees F. end point; 70 degrees A. P. I. gravity; 88-90 per cent recovery.

Amount of naphtha in blend—8 per cent.

In the second example the natural gasoline had the following specifications:

Initial—40 degrees F.; End Point—250 approx.; Gravity—90-95 degrees A. P. I.; Recovery—59 per cent.

The naphtha used for hot blending was as follows:

Initial—258 degrees F.; End Point—436 degrees F.; Gravity—48-50 degrees A. P. I.

The blend over the run averaged from 8 to 15 per cent naphtha with 85 to 92 per cent natural gasoline, and the resultant blended product had the following specifications:

Initial—68 degrees F.; End Point—420 degrees F.; Recovery—85-88 per cent; Gravity— 74.6 degrees A. P. I.

The blended product in all three examples was very stable, and the distillation curve was fairly uniform.

The actual theoretical blend according to formuli based upon the gravities of the products employed for blending in almost every case indicates that in an ordinary cold blend that it would require from 50 to 100 per cent more naphtha than was required in blending to a stable product through the apparatus under the conditions of heat and low pressure.

Equipment Used

The equipment as installed in the plants under discussion consists of regulation Newton pre-heaters, avaporators, and dephlegmators, as shown in the accompanying photographs. In operating the evaporative blending apparatus, the raw natural gasoline is pumped from storage tanks into a pre-heater where it is raised in temperature by steam to around 330 degrees Fahrenheit. From this pre-heater the gasoline vapors are conducted into the evaporator, entering the second compartment from the bottom.

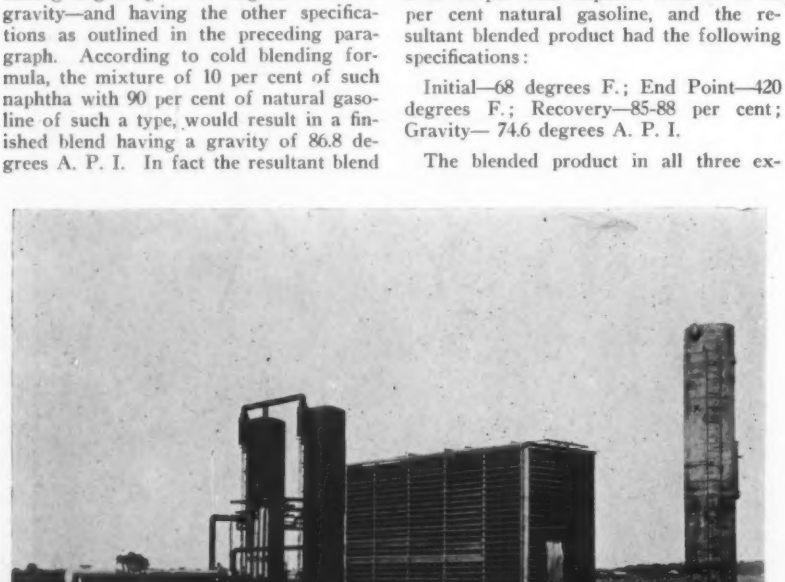
The cold naphtha is pumped into a pre-heater where steam causes its temperature also to be raised to around 330 degrees Fah. From this pre-heater the naphtha is conducted to the evaporator to enter at the top of the device and to spray downward through this equipment in counter current flow to the up-rising hot gasoline vapors. Steam is discharged into the lower section of the evaporator at about 120 pounds pressure and escapes through a trap. A small amount of live steam enters the lowest part of the evaporator at a pressure of about 15 pounds.

The vapors leaving the evaporator leave through a knock out box and enter a dephlegmator where they are cooled by naphtha which is by-passed into the dephlegmator while en route to the naphtha pre-heaters from the cooling tower. The reflux accumulating in the knock out box is conducted back into the evaporator, entering at the middle compartment. After the vapors leave the dephlegmator where they are cooled to around 210 degrees F., they then enter another knock out box. The reflux accumulated at this point is passed through a gaso-water separator and conducted into the raw gasoline pre-heater section.

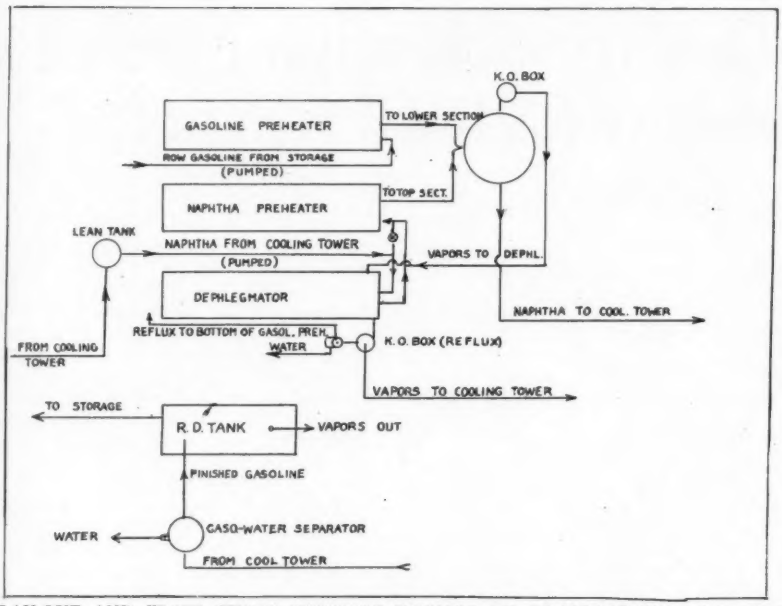
The vapors leaving the second knock-out or reflux box are then cooled and condensed in a water spray cooling tower. The condensate is then passed through a gaso-water separator, and enters an accumulator tank from where it is pumped to storage as finished product.

The excess naphtha circulated through the system is drawn from the bottom of the evaporator through a liquid level control into a clean oil tank, from which it is pumped into the naphtha pre-heater and recirculated through the system.

The evaporative blending plant is lo-



HOT BLENDING OF SEMI-VAPOR PHASE BLENDING PLANT IN OPERATION AT VINCENNES OIL & GAS COMPANY PLANT.



LAY-OUT AND FLOW CHART SHOWING DETAILS OF CONSTRUCTION AND OPERATION OF EVAPORATIVE BLENDING PLANT.

cated in a district in which there are several small compression gasoline plants, and the products derived from all of these plants are transferred by blowing with plant pressure from these outlying gasoline plants to storage tanks erected at the centrally located blending apparatus. There is naturally some loss incurred in this transfer of the highly volatile gasoline, but upon reaching the blending plant evaporation loss ceases. Vapors are taken from these storage tanks and passed through a nearby compressor unit where the gasoline components of such vapors are recompressed and condensed. The gasoline thus prepared is then passed through the blending apparatus along with the other compression gasoline. After the gasoline is subjected to the hot, semi-vapor phase blending procedure, the finished product is no longer "wild" but is capable of being handled by pumps, and is transferred to the nearby refinery without further appreciable losses, where it is utilized in the preparation of motor fuels. The system has the advantage of being economical of operation and first cost of installation is low. Blending losses are virtually eliminated and stability of the finished product is assured. The complete unit as assembled requires but little area and may conveniently be installed in a small space in the corner of the plant yard.

Through experimenting including manipulation of temperatures, pressures, and rate of feed, etc., one of the blending plants located at Bridgeport, Illinois, has secured excellent results along the lines of a still further reduction of naphtha percentage used in the blends. This plant is virtually a duplicate of the two installations as illustrated. The compression gasoline at this plant suffered an evaporation loss running from 25 to 30 per cent. Its specifications were as follows:

Initial, 40 degrees Fah.
End Point, 235 degrees F.
Gravity, 92.6 degrees A. P. I.
Vapor tension, 26 pounds.

The blending procedure was the same as in the plants previously discussed, using naphtha having an initial of 170 degrees F. with a gravity of 52 degrees A. P. I. and 482 end point. In this plant the blending system in operation produced a finished product having an initial of 58 degrees F., a gravity of 81.5 degrees A. P. I. with a 318 degree end point and a vapor tension of 10 pounds per square inch. This stable gasoline was prepared by blending with only four per cent of the naphtha as described. In practically all of the operations the very low proportion of naphtha used in blending has been effective in reducing the vapor pressures from around 20 to 25 pounds to around 10 and 12 pounds per square inch, and 100 degrees Fah. This points to the effectiveness of the hot blending procedure in securing stability of the finished product.

Physics of Blending

In view of the results secured by hot blending as outlined in the foregoing discussion, and which are now a matter of record, it may be of interest to look into the physics of solution and blending, for blending is merely the intermixture of distillates in solution in one another. In preparing solutions of refinery distillates and gasoline plant condensates, one with the other or others, the molecular attraction called cohesion peculiar to each component is overcome. Cohesion is that force which holds the molecules together. In making solutions the molecules of each component, so as to speak, merely move aside to allow the molecules of the solute room, or space enough, making for intimacy of contact. The invading solute is given space enough for its peculiar molecules to mix and mingle with those molecular particles of the solvent.

Solution may be speeded by the weakening of the cohesion peculiar to a substance. Quoting an article by the writer appearing in The Refiner and Natural Gasoline Manufacturer, issue of April, 1923, page 16, "This weakening of the force of cohesion is generally accomplished by the application of heat. The force is weakest with substances in the gaseous state, and stronger in the liquid state, and strongest with solid matter. Work in mixing petroleum distillates and natural gas condensates, however, must proceed in using liquids because of the commercial impracticability of vaporizing the various components." Since the progress of the industry in technical or scientific matters has proven that hot blending, or semi-vapor phase blending, is not commercially impracticable, the writer wishes to retract that statement. The discussion of the weakening of the force of cohesion through the application of heat to volatile liquids, points, however, to the success of the present system of evaporative blending.

Physical Laws

Solutions of the type prepared as blends by either hot blending or cold blending procedure can be termed as "singular solutions" insofar as the vapor pressure curve shows a maximum or minimum, indicating the formation of a constant boiling point mixture. In elucidation of the foregoing, the law of Wuellner is cited, "The lowering of the vapor pressure of a solvent is approximately proportional to the quantity of the solute dissolved in it, if the quantity of the solute be very small." Applying this law, it is found that the boiling point of solutions of hydrocarbon fractions is influenced directly by the concentration (volume) or dilution. Within certain limits the boiling point of natural gasoline will be raised by certain mixtures of fractions. Any increase in volume or percentage will then tend to depress the boiling point. The law of Bladgens is given to augment this conclusion, "The depression of the freezing point, or the increase of the boiling point of a solution is for small concentrations proportional to the amount of dissolved substance." For further augmentation, the law of Le Chatelier is cited, "If a system in physical or chemical equilibrium be subjected to a stress involving a change in temperature, pressure, concentration, or similar stress, the state of the system will automatically tend to alter, so as to minimize the effects of the stress." The raising of boiling points is explained by the fact that solutions of heavier fractions with light

(Continued on page 108)

Suggestions on the Manufacture of Steam Refined Cylinder Stock

By BENJ. KALHOFF

THE manufacture of steam refined cylinder stock is a source of profit that most oil refiners have been overlooking. It is true that with the advent of improved manufacturing processes much finer oils are being produced with the result that ordinary cylinder stocks have been forced out of many uses which they were formerly put to, but by no means abandoned. Where a transparent product is required steam refined stock will not do, however, this is not always required or necessary. Its use for automobile transmission oil is in fact larger than ever before.

There are a few small refiners who are working up their entire residuum into cylinder stock, which nets them about three times as much as fuel oil would. It requires a little solicitation to sell it but no more than is required to obtain a satisfactory price for other products. If only occasional sales are made, the price always justifies the effort. The point is, that many refiners have abandoned the thought with the conclusion that there is no market at all for it, with the result that a few are doing an excellent business with it.

This simply shows the rapid changes the industry is constantly undergoing, and to some extent accounts for its remarkable growth as there is always a profit to be made if it can be discovered quickly enough.

Cylinder stock is not difficult to make and does not require very much skill or equipment and in most plants only some slight changes need be made in the vapor lines so that they will recede from the still (shell still).

Suitable Crude Oil

It is of first importance to have suitable crude, primarily it should be light green in color, regardless of what importance color is, the fact remains the light colored stocks are the most saleable as is the case with about all petroleum products. Some refiners use mixed or pipe line crude and treat the crude or the residuum chemically and then reduce it to stock. While this practice produces a satisfactory product, the refiner who uses this method is at a serious disadvantage due to added cost of manufacture and in some cases might profit by buying either more suitable crude or finished stock from another refiner more favorably situated. Just why this is not more often done is not quite clear.

Assuming that a satisfactory crude is available, a simple laboratory steam still distillation to 20 degrees to 22 degrees Be. residuum may be made from which the usual tests: gravity, flash, fire, viscosity and pour may be determined.

Several tests may be required before a conclusion can be reached as to which is the best way to produce the best product. In a general way the objects sought for in refining to cylinder stock are:

First: Holding the color as near the color of the crude as possible.

Second: Removal of all light ends, gasoline, kerosene, gas oils, etc., and as much paraffine wax as is possible without cracking.

Third: Avoid too high temperatures or rather avoid "back trapping" by use of steam.

The idea being to reduce the "bottoms," (usually 18 to 22 per cent) to proper tests at as low temperature as possible consistent with reasonable time. Fifteen to 24 hours is required for ordinary 800 barrel shell stills, depending upon the hook up.

Advantage of Live Steam

The reason for using live steam directly into the oil is to take advantage of the Law of Partial Pressures which enables the operation to be carried on at temperatures low enough to avoid scorching or darkening of the finished stock. The use of steam is about the only point that requires skill on the part of the operator and the time required and the quality of product produced depends very much on judicious use of steam. It is safe to say that too much steam, if not too wet, would only be wasteful, whereas not enough would mean a spoiled batch. As a rule most operators do not use enough steam. It is seldom that a temperature of over 600 degrees F. is required. Most crudes can be handled at 560 degrees to 580 degrees F. A strong smoky odor is evidence of too much heat and not enough steam, if the odor is not too pronounced and the color has not been lost, some quick work getting in a little more steam will save it. If at this point a flash test is made it will usually show that it will flash at a lower temperature, due to the fact that destructive distillation has set up and produced some lighter boiling point fractions.

If this condition is not quickly controlled the whole batch will become darkened, due to carbon formation.

Steam must be used in the stills as soon as the temperature of the oil will safely permit, 350 degrees F. By this is meant that if the oil is not hot enough, the steam would condense and settle as water to the bottom of the still, striking the bottom hot sheet and would be regenerated into steam so violently that it would foam up the colder oil higher up and boil over into the vapor line, generally called "puking." Operators should always make sure that the steam line is drained and free of water, before turning steam into a still. All stillmen have been told this many times but once more for good measure will do no harm.

Reduce Steam Last

Steam refined stock, as the name implies, means just that. The importance of the free use of steam can not be overestimated. When a still seems to be running unreasonably hot and "blowing" too much it is advisable to look to other means of control before cutting out steam. It may be possible to get more water through the condensers or colder water or by reducing the fire. Just keep in mind that when you attempt to regulate the steam or rather reduce it you are taking a chance on your product going off color and test. Violent blowing is more often due to other causes than too much steam.

Some plants have had trouble in getting uniformity. The reason for this at one plant was that the stillman was required to go some distance to the laboratory (in this case about 2000 feet) and together with the loss of time in making a test caused the still to run too long or not long enough. The result was that the stillman was required to do some guessing. To overcome this the stillman was permitted to make some of these tests himself at a near point.

Checking Color

In making flash tests, the operator soon becomes proficient and develops a sort of technique all his own and it is surprising how close these tests compare with careful laboratory tests.

In checking color the finished stock should be compared with the crude it is made from. If the finished product represents, say 20 per cent of the crude, it may be mixed with 80 per cent gasoline or what ever percentage gasoline required to make 100 per cent. Compare this with the crude from which it is made. It should almost match in color.

When a batch of stock is finished to test it should be left in the still from 15 to 20 minutes after fires are out to dry out the moisture from the steam. It is then ready to pump out. This is a bit of profit many refiners can take and usually without additional equipment.

Cracking Equipment Deterioration Shown by Inspection Figures

By H. L. KAUFFMAN
Petroleum Consultant, Denver, Colo.

IN the November, 1926, issue of The Refiner and Natural Gasoline Manufacturer appeared the paper relative to the inspection of pressure cracking equipment, prepared and read by Franklin L. Newcomb of the engineering department of the Standard Oil Company of New Jersey, at the Petroleum Section, National Safety Council, Detroit, Michigan.

Mr. Newcomb stated in the paper referred to that there are three main factors entering into the safety of refinery processes, as follows:

"1. The equipment used must be suitable for the job, that is, it must be made of the right material, properly put together and of ample strength. This is a problem of design and an engineering function.

"2. The proper methods must be used in handling the equipment and performing the various operations. This is a problem of operation.

Systematic Inspection Essential

"3. The equipment must be kept in good condition at all times. This is a problem of inspection and maintenance."

Concerning the deterioration in pressure cracking equipment and the means for the inspection of same, Mr. Newcomb had the following to say:

"Some of our companies have also an engineering inspection force to make more exhaustive inspections of equipment than can be done during the cleaning period by the maintenance forces. These engineering inspection forces were an outgrowth of the advent of cracking. After cracking equipment had been in operation for a number of years, serious failures began to occur and the industry began to make an investigation. It was found that cracking equipment deteriorated quite rapidly, especially in some particular places. As it operated under considerable pressure, it could not be permitted to go until leaks occurred or a sharp blow from a hammer would indicate a weak spot.

"So gradually these engineering inspection forces were built up to make periodic, systematic inspection of the equipment.

"The deterioration in cracking equipment is difficult to determine, as it is not visible to the eye, there usually being no marked, pitted or corroded areas. Generally the metal has the same smooth appearance as when new. However, the deterioration is not uniform, but often occurs in long waves which cannot be seen and for this reason it is difficult to locate the thinnest spots.

"Parts thinner than others can ofter be found by sounding with a light hammer, but it takes an experienced and trained man to know the sound. Due to the nature of the deterioration, it has become generally the custom to drill holes in various parts of the equipment to determine its actual thickness. These inspection forces also check over all parts of the equipment, including pipe, valves, gauges, safety valves, etc., and check up to see that the refinery's maintenance forces are keeping everything in a safe condition.

"The field covered by these engineering inspection forces is being gradually widened and inspections have been made of storage tanks, gas absorbers, gas holders, air receivers, acid and alkali eggs and such things. Men trained to inspect cracking equipment are admirably fitted to inspect any pressure equipment."

Nearly all superintendents of refineries in which cracking equipment is installed have tests made at regular intervals on the walls and lines of pressure equipment. Usually, when operations have been conducted for a period of time on the same charging stock, or on charging stocks of similar characteristics, it is possible to calculate fairly accurately the monthly rate of weakening of the walls of the equipment. However, when the charging stock is changed, it is self-evident that the periods of inspection should be more frequent until the new rate of weakening once more is learned.

The results of the inspection at different periods of various parts of the equipment composing a Holmes-Manley type of pressure cracking installation will be discussed in detail in the present article.

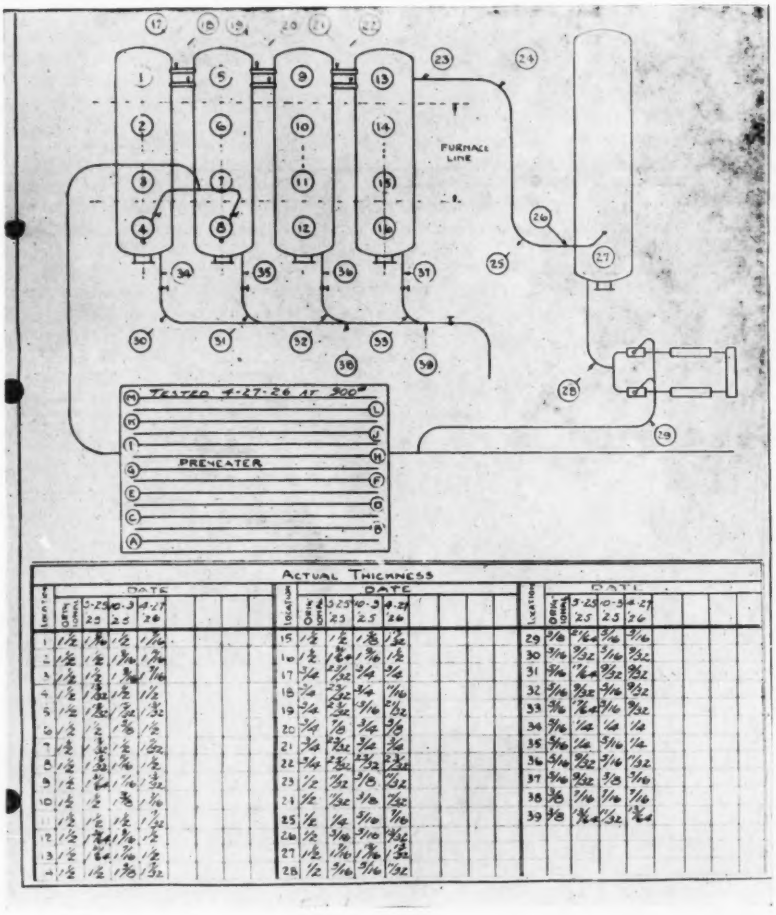


FIGURE 1.

Process Described

For the benefit of the reader who is not familiar in a general way with the construction or operation of the Holmes-Manley stills, the following brief description by R. C. Holmes (one of the co-in-

ventors), from a paper read at a meeting of the Petroleum Division, A. I. M. E., New York City, N. Y., February 15, 1926, is given:

"The Holmes-Manley apparatus most generally in use, comprises a pre-heater coil, of the series type, in which the oil is raised to a full cracking temperature; four vertical stills, into which the oil discharges; a bubble tower type of dephlegmator, which receives the vapor from the stills; a reflux condenser, to which the vapors pass from the top of the bubble tower; a water-cooler condenser which receives vapors from the reflux condenser; a surge pump, or jet pump, which returns the clean, heavy condensate from the bottom of the bubble tower and forces it into the stills through a pre-heating coil; expansion drums, into which the bottoms, or residue, from the stills are drawn and distilled largely by contained heat; and a condenser coil for condensing the vapors from the expansion drums.

"The oil traverses the heating coil so rapidly that while it is heated to full cracking temperature—approximately 800 degrees F. (not high enough, however, to damage the coil)—there is no substantial decomposition of the oil in the coil, and hence carbon trouble here is avoided.

"Oil is maintained at an approximately even level in the vertical stills, which are set in a furnace with the ends projecting above and below the furnace, and heat is applied to the side walls, within the furnace.

"Scrapers are mounted on vertical shafts in each still and are rotated during the operation, thus preventing the accumulation of carbon on the heated surfaces. Any carbon which is formed tends to gravitate to the cooler bottom space, below the heated zone.

"The oil in the stills is equalized by liquid inter-connections, just above the furnace at the point where it is desired to maintain the oil level, the vapor being taken off the stills as fast as formed and led directly to the bubble tower.

"Comparatively low furnace temperature is maintained around the stills as only a moderate heat is necessarily applied at this point, most of the heat being supplied to the oil in the coil. The oil is maintained in the stills to a slightly lower temperature than at the exit of the coil. Cracking being carried on in the stills at relatively low temperature, approximately 775 degrees F."

Results of Inspection

Figure 1 shows a sketch indicating the essential equipment used in the Holmes-Manley process with number references showing the points in the equipment at which the walls were measured at different periods of time; also, data showing the original wall thickness at the points referred to (this particular battery is of the "Class 500" type Holmes-Manley vertical still and was placed in operation October 18, 1923), and the wall thickness at the same points on May 25 and October 3, 1925, and April 27, 1926.

Figure 2 shows similar data obtained on the same general type of Holmes-Manley unit which was placed in operation on March 25, 1924. Measurements of the wall thickness were taken on this battery (at the same points indicated by the numbers in the sketch, Figure 1) on June 2 and October 5, 1925, and on May 4, 1926.

Figure 3 shows data obtained on a "Class 250" Holmes-Manley vertical still which was placed in operation on February 2, 1924. Measurements of the wall thickness of the essential equipment composing this battery were taken (also at the same points indicated by the numbers in the sketch, Figure 1) on June 2 and October 8, 1925, and on April 19, 1926.

Reference Nos. 1 to 16, inclusive, refer to four points on each of the four vertical stills; Nos. 17, 19 and 21, to points on the vapor equalizing lines that join the upright stills; Nos. 18, 20 and 22, to the liquid equalizing lines joining the still; Nos. 23 to 26, inclusive, to four points on the vapor line leading from the side, near the top, of the fourth upright still to the bottom of the bubble tower; No. 27, to a point at the bottom of the bubble tower; No. 28, to a point near the surge pump, on the hot reflux suction line leading from the bottom of the bubble tower to the surge pump; No. 29, to a point, also near the surge pump on the hot reflux discharge line leading from the surge pump to the cracking coils; and Nos. 30 to 39, inclusive, to ten different points on the residuum draw-off line.

Comparisons

The original shell thickness of the upright stills in the "Class 500" batteries was 1½ inches; of the "Class 250" battery 1¼ inches.

The liquid and vapor equalizing lines on the battery referred to in Figure 1 ("500" type) was, originally, ¾-inch in thickness; on the "500" class battery indicated by the data shown in Figure 2, ⅞-inch, which thickness was the same as that of the liquid and vapor equalizing lines on the "250" class of Holmes-Manley vertical still referred to in Figure 3.

The vapor line leading from the fourth still of the battery to the bottom of the buble tower, on both the "Class 500" and "Class 250" batteries (Figure 1, 2 and 3) was, originally, ½-inch in thickness; while the original wall thickness of the bubble tower on all three batteries was 1½ inches.

The hot reflux line on the "500" type of battery (Figure 2) and on the "250 Class" (Figure 3) had an original thickness of ⅜-inch. On the "Class 500" unit referred to in Figure 1, the wall thickness of the line on the suction side of the pump, originally, was ½-inch; while on the discharge side, on this same battery, it was ⅜-inch.

The original wall thickness on the residuum draw-off line on all batteries examined was 5/16-inch at all points except those indicated in the sketch (Figure 1) as Nos. 38 and 39, at which points the wall thickness of the line was ⅜-inch.

Concerning the results of the inspection of these units, at different points, at the various periods of time mentioned, scarcely any additional comments are necessary other than that which can be learned by studying the data given in the figures.

Greatest corrosive action and wearing away of the steel was noticed on the vapor and liquid equalizing lines, although, in the case of the "500" type battery, data on which is given in Figure 1, it was no greater than at other points in the equipment; in inspecting the other batteries, the corrosive action at these particular points was more noticeable.

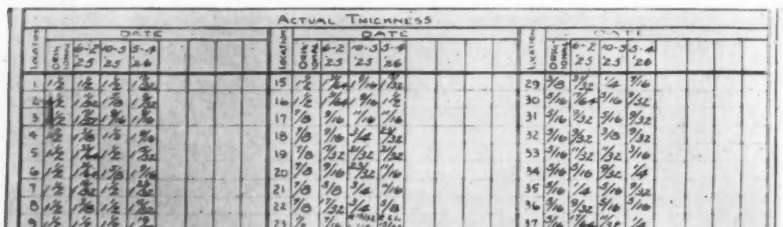


FIGURE 2.

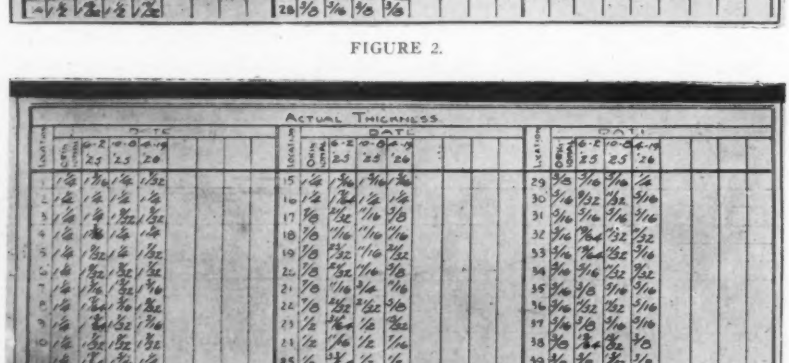


FIGURE 3.

Catalysers and Their Effects Upon the Oxidation of Mineral Oils

By GEO. W. CUPIT, JR.,
Chemical and Refining Engineer

THE subject which has been uppermost for years in the mind of the refiner is sulphonation with various strengths of acid using air as a means of agitation.

Today, with the rapid advancement in the refining of mineral oils a subject equally important is that of oxidation in the absence of and in the presence of catalysers. It is a well known fact that when oils are heated in the presence of air certain definite changes take place in the oils which result in the formation of solid asphaltic and coky substances depending upon the degree of heating.

At low temperatures, (Approximately 210-270 degrees F.) this change is not so noticeable with the result that instead of the substances being of a hard nature they are of a resinous and highly viscous nature, which readily settle to the bottom of the oil on standing.

At higher temperatures, (360-450 degrees F.) however, the formation of the insoluble substances is very noticeable. At both low and high temperatures other changes were noticed namely: the oils changed from a sweet to a pungent odor, increased in viscosity, darkened in color, and became heavier in gravity.

Object:—To study the changes that take place in oxidation and to determine the catalysts possessing the greatest effect.

Method:—The method used was to heat the oil to the temperature desired, agitate with air in the presence of the catalyst, care being taken to maintain the desired temperature throughout the reaction.

Catalysers used: Vanadium Pentoxide, Powdered Metallic Iron, Powdered Metallic Tin, Powdered Metallic Aluminum, Powdered Metallic Nickel, Reduced Copper, Cuprous Oxide, Cupric Oxide.

In the presence of Vanadium Pentoxide alone, no catalytic effect was noticed but upon the addition of a small amount of Chromic Acid the effect was rapid and very marked. No catalytic effect was noticed in the case of powdered metallic iron, tin, nickel, aluminum and cupric oxide.

Changes With Copper

In the presence of reduced copper, however, the following changes took place: The oil had a pungent odor, remained clear while heated but became hazy on cooling, increased in viscosity, became heavier in gravity, decreased in bloom, deposited an highly viscous resinous substance which upon extraction with naphtha and dried, gave a hard and brittle residue possessing a brownish-black color. The following solvents dissolved the powdered residue completely: carbontetrachloride, titanium tetrachloride, benzol, acetone and grain alcohol.

It was interesting to note that the residue was high in nitrogen content and showed the presence of sulphur which undoubtedly gave it an undesirable taste and odor. Heating a portion of the original oil with the residue caused the residue to dissolve in the oil. The recovery of the nitrogenous residue was made possible by extracting with alcoholic sodium hydroxide and reprecipitating with dilute sulphuric acid.

Sulphonation of mineral oils oxidized in presence of catalyser: Strength of sulphuric acid used (66 degrees Be.—93.0 per cent acidity). Treatment of the above oil removed those compounds which gave a high iodine substitution value and therefore, increased the iodine addition value of the oil. This fact led the writer to believe that unless the neutralized oils were given a severe washing treatment the sodium sulphonates (formed by neutralization of acid treated paraffin base oils), or sodium naphthenates, (formed by neutralization of acid treated naphthenic base oils), would cause a high ash content and incidentally a high Conradson carbon test. This proved to be the case rather than the exception even after a severe washing treatment. The oil had to be washed several times due to the tendency of the oil to emulsify. The only satisfactory method for the removal of the undesirable soaps was that of "Selective Solubility."

Results

If a mineral oil is oxidized as above described and then treated with 66 degree Be. sulphuric acid and the same oil, unoxidized is acid treated in like manner, it will be found that the acid will not only treat out a greater proportion of the oxidized oil than the unoxidized oil, but that the oxidized oil will contain a smaller amount of hydrocarbons removable by acid.

This information was checked and found to be true by subjecting various transformer oil stocks to oxidation in the presence of the catalysts, acid treating, neutralizing, washing, drying, then giving severe sludge tests such as the French and Holde. The sludge tests were much lower in the case of oxidized oils.

This led to the belief that white medicinal oils could be made by repeated oxidation and acid treating without the use of stronger acid and although this procedure gave oils of low iodine values and lower solubility in fuming acid, the treating losses were too great and the oils were very difficult to refine.

The following elements were studied in this work in the presence of catalysers and are as follows:

(A)—Nature of Distillates.
(B)—Temperature.
(C)—Time.
(D)—Amount of Catalysers Used.
(E)—Presence and Absence of Sunlight.

(A)—Nature of Distillates

1. Uncracked distillates from Paraffine Base Oils ranging in viscosity from 85-140 Vis. at 100° F. (Saybolt).
2. Cracked distillates form Paraffine Base Oils ranging in viscosity from 85-140 Vis. at 100° F. (Saybolt).
3. Uncracked distillates from Naphthenic Base Oils ranging in viscosities from 85-500 Vis. at 100° F. (Saybolt).
4. Cracked distillates from Naphthenic Base Oils ranging in viscosities from 85-500 Vis. at 100 F. (Saybolt).

In every one of the above cases the oils that were oxidized with air in the presence of the catalyst gave a positive reaction with the formation of solid residues which were soluble in the previously mentioned solvents and were readily saponifiable.

(B)—Varying Temperatures

The above distillates were oxidized in the presence of reduced copper at temperatures ranging from room temperature to 460 degrees F. At temperatures above 220 degrees F. the oxidizing effect and precipitation of solid substances were rapid—the speed of reaction being directly proportional to the increase in temperature.

(C)—Time Study

As above, the amounts of solid substances formed on oxidizing for various periods of time were found to be directly proportional to the lengths of time blowing. It was interesting to note that by doubling the time of blowing the percentage by weight of solid substances formed was doubled and by trebling the time of blowing the percentage by weight of solid substances formed was trebled. This ratio remained constant in every case.

(D)—Amount of Catalyst Used

The only variable in the oxidation was the amount of catalyst used. In

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Action of Sulfur Monochloride On Petroleum Hydrocarbons[1]

By EUGENE LORAND

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Reprinted from Industrial and Engineering Chemistry.

The action of sulfur monochloride on petroleum hydrocarbons has been investigated on both single hydrocarbons and petroleum fractions, and found to be a general reaction of unsaturated hydrocarbons. It consists probably of chlorination and subsequent condensation or polymerization.

Two methods are suggested for testing the degree of unsaturation of hydrocarbons and petroleum products on the basis of this reaction.

IN searching for a solvent for petroleum fractions which could be removed without distillation, a surprisingly energetic reaction was observed between sulfur monochloride and the different fractions. Heat development, change of color of the solution, effervescence, and the escape of hydrogen chloride mark the reaction. The higher boiling the fraction, the more violent it reacts when mixed with sulfur monochloride.

It is peculiar that the literature of organic chemistry, especially that of the aliphatic hydrocarbons, contains very little about this reaction. The action of sulfur monochloride on ethylene as used in the manufacture of mustard gas, and a similar reaction with amylene described by Guthrie[2] are apparently the only exceptions.

Meigs[3] described the action of sulfur monochloride on certain substances which he designated as "asphalt B," "tar binder B," and "gas engine oils." He attributed the reaction to the presence of bituminous substances, and tried to develop a testing method for them, based on the use of sulfur monochloride. In careful experiments he excluded the presence of moisture and determined the rate of hydrochloric acid evolution during the reaction. However, the present experiments showed that the higher fractions (above 300 degrees C.), and crude oils react more violently than water alone. Thus the reaction, especially the evolution of hydrogen chloride, is not due to the presence of moisture.

In the present work the reaction was found much more general than Meigs supposed. Different kinds of lubricating oils reacted violently; higher kerosene fractions were attacked a little less vigorously; various motor gasolines changed color when mixed with sulfur monochloride and after standing a dark sediment settled out. Moderate heating started a more energetic reaction.

The reaction can be carried further by heating after first energetic action is over, as the following experiment will show:

Thirty-five grams of sulfur monochloride were allowed to flow gradually from a separatory funnel into an Erlenmeyer flask containing 100 grams of a petroleum fraction boiling between 225 degrees and 250 degrees C. When the reaction became less vigorous, the mass was heated for several hours on a water bath with refluxing. The oil became tarry, and after cooling monoclinic sulfur crystallized. The liquid was freed from the unchanged sulfur monochloride by distillation. On account of foaming, the further fractionation of the reaction product was made at an absolute pressure of about 50 mm. of mercury. The first drop came over at about 120 degrees C., and the temperature rose to as high as 175 degrees C. toward the end of the distillation. About 75 per cent of oil was recovered. A considerable amount of carbonized product remained in the flask. Seventy-five cubic centimeters of the distillate were fractionated under normal pressure. The first drop came over at 210 degrees C and 7 cc. distilled below 225° C. The volume of the 225-250 degree C. fraction was 49 cc. The end point was 278 degrees C.

The results indicate that the distillate contains not only the hydrocarbons unaffected by sulfur monochloride but also polymerized and condensed or chlorinated compounds or their cracked products.

Tests on Single Hydrocarbons

A detailed study of this reaction was made on single hydrocarbons. The first step was to determine what types of hydrocarbons do react with sulfur monochloride. Normal pentane, normal hexane, decane (diisoamyl), and commercial amylene were available. In all cases the procedure was the same:

Thirty to fifty grams of the hydrocarbon were mixed cold with about half as much sulfur monochloride and then refluxed on a water bath for 5 to 8 hours. The saturated hydrocarbons apparently did not react when cold, nor did heating start a reaction except in the case of diisoamyl, the color of which was changed. However, more thorough examination showed that there was some reaction in all cases. The unchanged sulfur monochloride was hydrolized by dilute sodium hydroxide and the oil was washed until neutral. The sulfur was filtered off and the reaction products were tested for chlorine and sulfur. Both reactions were positive. As sulfur crystallized on longer standing, the liquid was distilled and tested again. The chlorine reactions remained positive, but the sulfur test was negative.

Since these saturated hydrocarbons were not chemically pure, the same experiments were repeated after treating them with fuming sulfuric acid in order to eliminate the unsaturated hydrocarbons. No difference was found in the behavior of the treated hydrocarbons with sulfur monochloride.

The behavior of commercial amylene was entirely different. There was no reaction at ordinary temperature, but after heating slightly violent evolution of heat and change of color took place. The reaction product became brownish black and tarry. Chlorination could be proved easily, but no test for sulfur could be carried out on account of its solubility in the reaction product. Further, it was not possible to separate the two by solvents because of their similar solubility. Chemical agents such as hot sodium hydroxide would also react with any combined sulfur present. Distillation, even under vacuum, caused cracking and carbonization.

Tests on Petroleum Fractions

These facts indicate an outstanding difference between saturated and unsaturated hydrocarbons as regards their behavior with sulfur monochloride. It seemed advisable to check the above results on petroleum fractions which were freed from their unsaturated constituents by a treatment with fuming sulfuric acid. The following results were obtained:

Commercial Gasoline — The same procedure was carried out with various samples as in the case of the single hydrocarbons. The sulfur monochloride did not seem to react either cold or hot. However, before distillation, both chlorine and sulfur reactions were positive. The distillation was smooth and gave about the same fractions as the untreated gasoline; but at the end

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[1]Received January 24, 1927.
[2]J. Chem. Soc. (London), 12, 112 (1860).
[3]This Journal, 9, 655, (1917).

Discussion of Isothermal and Adiabatic Compression

By A. K. HEGEMAN

DURING the past two years some experiments have been very quietly conducted at an absorption plant in the Mid-Continent field which have resulted in the granting of certain patents which will undoubtedly prove to be of considerable interest to operators of natural gas compressor plants.

Throughout the entire United States, but more particularly in the fields of Pennsylvania, Ohio, West Virginia and California, the necessity of conservation of fuel gas has been facing the oil operators with increasing importance each year. Some operators have met this problem by eliminating from their plants as much steam equipment as possible, substituting therefor electric motors or natural gas engines as prime movers. Other operators have added condensers and boiler feed water heaters to their equipment while still others have standardized on the four cycle type of gas engine in preference to the heretofore less oconomical (from a fuel standpoint) two cycle type of engine.

The fact that the four cycle type of natural gas engine burns less fuel when in perfect adjustment than is burned by the two cycle type is admitted by all, but many are strong in their belief that the percentage of fuel economy is generally exaggerated and that the simplicity and lower maintenance cost of the two cycle engine more than offsets its waste of fuel gas. This waste of fuel gas has been due to the practice of scavenging with a mixture of air and fuel, a portion of this mixture following the burned gases out the exhaust ports.

Any engineer who is familiar with Diesel engines knows that the two cycle Diesel shows as great, if not greater, thermal efficiency than the four cycle Diesel. Both are sold under identical fuel consumption guarantees, about .45 lb. of 18,500 BTU fuel oil per brake horsepower hour. This is equivalent to 8325 BTU per brake horsepower hour and the thermal efficiency of such an engine is therefore 30.6 per cent.

A question therefore arises as to why both types of Diesel engine (we may neglect the cheaper type of Diesel which utilizes crank case compression), show the same thermal efficiency while the two cycle natural gas engine shows a thermal efficiency as much in some designs at one-third lower than the usual 25 to 26 per cent shown by the ordinary two cylinder horizontal four cycle engine with which we are all familiar.

The answer lies entirely in the scavenging system. The two cycle Diesel scavenges with pure air and fuel is not admitted to the cylinder until scavenging is complete. That scavenging accomplished in this way is as effective as the four cycle type of scavenging is proved by similar thermal efficiencies and fuel consumption. Pure air admitted to the cylinder of the two cycle engine under a few pounds pressure undoubtedly does not force all the burned gas out the exhaust ports, but it must be borne in mind that all of the burned gases in the four cycle cylinder are not ejected on the scavenging stroke. There is always a considerable clearance space between the end of the piston and the cylinder head which is full of burned gas at the instant that the scavenging stroke is completed and this burned gas is left in the cylinder to mix with the next charge of fuel. In the case of a four cycle engine which shows a compression of 85 pounds gauge, this clearance space is equal to approximately one-seventh of the total volume of the cylinder. Every six parts of fresh fuel which are admitted therefore mixes with one part of burned fuel and the resulting mixture is only about 86 per cent pure. A two cycle engine scavenged with pure air before the admission of any fuel undoubtedly would show approximtely the same scavenging efficiency. The weakness of the two cycle natural gas engine has not been failure to eject burned gases so much as it has been the escape of fresh fuel through the exhaust ports. The two cycle Diesel scavenges with pure air, admits the fuel only after closure of the exhaust ports so that no fuel can possibly escape through the ports, and therefore, shows as high a thermal efficiency as the four cycle Diesel.

It should be borne in mind that a four cycle engine, while it will operate on 10,000 BTU (or slightly less) per B. H. P. hour when in perfect adjustment, seldom shows this efficiency under field conditions. The moment that wear of the valve seats begins to occur, loss of compression and thermal efficiency is bound to result. Some operators constantly utilize the indicator and through its use are able to keep their four cycle units up to a high state of efficiency, but the operator who attempts to operate engines of this type without a check on their performance would in most cases be disagreeably surprised were he to have competent engineers make a careful check of his thermal efficiency.

During the year 1926, A. W. Hubbell, an official of a Mid-Continent operating company, perfected and patented a method of injecting fuel into a two cycle natural gas engine after closure of the exhaust ports had occurred. He thus made it possible to scavenge the engine with pure air just as is the custom with two cycle Diesels. The apparatus and method patented by Mr. Hubbell aroused considerable interest among builders of two cycle engines and arrangements have been made by some of these manufacturers whereby they may operate under the Hubbell patents. By this method the cylinder is scavenged with pure air, following which the exhaust ports are closed. At the moment of closure fuel is injected under a pressuree not necessarily exceeding 15 pound gauge, a pressure which is available at most places where such an engine would be used. Fuel compressors or pumps are therefore unnecessary.

The adoption of what we might call a two cycle Diesel engine cycle has resulted in an increase of the thermal efficiency of the horizontal one or two cylinder two cycle gas engine which apparently not only equals, but even exceeds, the thermal efficiency of all except possibly the most highly efficient type of multi-cylinder four cycle engine. It is a fact that carefully conducted tests with calibrated indicators and meters reveal that these two cycle engines will operate at rated load on 8650 BTU per brake horsepower hour, this being equivalent to 29.4 per cent thermal efficiency. This compares favorably with the 30.6 per cent of both two and four cycle Diesels and more than favorably with the usual 25 to 26 per cent shown by most one or two cylinder horizontal four cycle engines. The Hubbell injection apparatus is very simple and there is nothing to get out of adjustment. The development of this apparatus has passed the experimental stage and it has been perfected.

PART II

Another question which is brought up at many times by engineers who are interested in plant efficiency is in connection with the isothermal and adiabatic methods of computing compressor capacities and horsepowers. Many overlook the importance of clearance in compressor cylinders when making comparisons and often take it for granted that two cylinders of identical diameter and stroke must of necessity pump the same amount of gas with the same horsepower consumption per revolution.

Clearance actually effects the horsepower required to compress one cubic foot of gas because excessive clearance might necessitate the use of a larger compressor cylinder in order to obtain a certain actual delivery of free gas against a certain pressure. The larger the bore of the compressor cylinder the greater the frictional losses and the greater the horsepower required to operate that cylinder and to deliver the gas.

Clearance also has a decided effect upon the capacity in actual gas delivered by a

cylinder as well as upon the horsepower required to operate the cylinder. Some engineers show a decided preference for the adiabatic method of figuring the effect of clearance upon volumetric efficiency, capacity, and horsepower, but at the same time admit that there is considerable difference of opinion regarding the proper value of the exponent N.

In order to stay away from the questionable exponent N, many prefer to use the formulas and curves as established by Thomas R. Weymouth in a paper published in the 1912 proceedings of the A. S. M. E. These formulas and curves are largely empirical and the result of an extensive series of indicator tests.

Weymouth very clearly points out that his tests showed him that the re-expansion curve very closely followed the isothermal curve and he therefore adopts the formula:

$$E=1-C\left(\frac{P_2}{P_1}-1\right), \text{ where}$$

E=volumetric efficiency
C=percentage of clearance
P_2=discharge pressure
P_1=initial pressure

To quote from Weymouth's paper: "It has been the custom of most engineers to consider that the actual mean effective pressure of compression follows the adiabatic law, and they have therefore used equations 39 and 41, with constants depending upon assumed values of inefficiency, or lost work, according to the judgment and experience of the engineer. Repeated tests have shown, however, that the work curve has charactertistics more nearly approaching those of the isothermal than those of the adiabatic, and in every case of which the author has any record the actual curve begins at zero, for zero suction, and rises between the isothermal and adiabatic curves until a point is reached at about 3.2 compressions, where it corsses the adiabatic and thereafter continues above it." The figures used in the above quotations refer to the adiabatic and isothermal equations for M.E.P. See Figure 1.

Then, later in his paper he states: "Inasmuch as the formula for the mean effective pressure represented by equation 42 is derived from actual operating conditions, it may be considered as taking into account all power losses. From a study of a great variety of indicator cards taken from many different types of compressors, the author has found that the re-expansion curve closely resembles the isothermal."

Equation No. 42 is Weymouth's empirical equation, as follows:

$$\text{MEP (mean effective pressure)}=2.3\,P_1\left[1.08+0.5\left(\frac{P_1}{P_2}\right)^2\right]\times\log\frac{P_2}{P_1}$$

Some engineers seldom refer to any clearance formulas except as a check but prefer to avail themselves of the volumetric efficiency tables which are furnished by many manufacturers. The values shown in these tables are usually the result of tests and are usually considerably lower than values derived from any of the adiabatic or isothermal formulas and any cylinder capacities which are obtained will as a result be considerably lower and more conservative than would be obtained by using the various formulas or the curves derived therefrom. Losses due to wire drawing, slippage, heating of the gas as it enters the cylinder and valve leakage have been taken into account in making up these efficiency tables.

Lucke's adiabatic formula for volumetric efficiency is expressed as follows:

$$E=1-C\left[\left(\frac{P_2}{P_1}\right)^{1/N}-1\right]$$

In the following example of the effect of clearance let us assume that N=1.3 and let us solve the following problem:

Given: Two 17"x20" compressor cylinders having a piston displacement D of 1,500,000 cubic feet per 24 hours. One of these cylinders has 5 per cent clearance, the other 10 per cent clearance.

What will be the actual delivery in free gas measured at compressor intake temperature of each cylinder when pumping from 0 lb. to 30 lb. gauge?

When pumping from 10-inch vacuum to 30 lb. gauge? What will be indicated compressor horsepower in each case?

Let us solve this problem both adiabatically and isothermally.

1. Isothermal Solution

P_1=14.7 Absolute
P_2=44.7 Absolute

$$E=1-C\left(\frac{P_2}{P_1}-1\right)$$

H.P. per 1000M=60 (Weymouth)

Cylinder A,—5% Clearance

$$E=1-.05\left(\frac{44.7}{14.7}-1\right)$$
$$=1-.1010$$
$$=.8990=89.90\%$$
$$D\times E\times\frac{P_1}{14.7}=1{,}500{,}000\times.8990\times\frac{14.7}{14.7}$$

= 1,350,000 cu. ft. actual delivery.
1.350 × 60 = 81 I. H. P.

Cylinder B,—10% Clearance

$$E=1-.10\left(\frac{44.7}{14.7}-1\right)$$
$$=1-.202$$
$$=.798=79.8\%$$
$$D\times E\times\frac{P_1}{14.7}=1{,}500{,}000\times.798\times\frac{14.7}{14.7}$$

= 1,197,000 cu. ft. actual delivery.
1.197 × 60 = 71.8 I. H. P.

$$\frac{1{,}97{,}000}{1{,}350{,}000}=88.7\%$$

2. Adiabatic Solution

P_1=14.7 lb. Absolute
P_2=44.7 lb. Absolute

$$E=1-C\left[\left(\frac{P_2}{P_1}\right)^{1/N}-1\right]$$

N=1.3
H.P. per 1000M=60 (Weymouth)

Cylinder A,—5% Clearance

$$E=1-.05\left[\left(\frac{44.7}{14.7}\right)^{1/1.3}-1\right]$$
$$=1-.05\ (2.34-1)$$
$$=.9330=93.30\%$$
$$D\times E\times\frac{P1}{14.7}=$$
$$1{,}500{,}000\times.9330\times\frac{14.7}{14.7}=$$

1,400,00 Actual delivery
1.4 × 60 = 84 I. H. P.

Cylinder B,—10% Clearance

$$E=1-.10\left[\left(\frac{14.7}{44.7}\right)^{1/1.3}-1\right]$$
$$=1-.10\ (2.34-1)$$
$$=1-.1340$$
$$=.8660=86.60\%$$
$$D\times E\times\frac{P_1}{14.7}=$$
$$1{,}500{,}000\times.8660\times\frac{14.7}{14.7}=$$

1,300,00 cu. ft. actual delivery
1.3 × 60 = 78 I. H. P.

$$\frac{1{,}300{,}000}{1{,}400{,}000}=92.8\%$$

3. Isothermal Solution

P_1 = 10" vacuum = 9.8 lbs. Absolute
P_2 = 44.7 lbs. Asolute

$$E=1-C\left(\frac{P_2}{P_1}-1\right)$$

H.P. per 1000M=86 (Weymouth)

Cylinder A,—5% Clearance

$$E=1-.05\left(\frac{44.7}{9.8}-1\right)$$
$$=1-.1780$$
$$=.8280=82.80\%$$
$$D\times E\times\frac{\quad}{\quad}=$$
$$1{,}500{,}000\times.8280\times\frac{9.8}{14.7}=$$

828,000 cu. ft. Actual delivery
.828 × 86 = 71.2 I. H. P.

Cylinder B,—10% Clearance

$$E=1-.10\left(\frac{44.7}{9.8}-1\right)$$
$$=1-.356$$
$$=.644=64.4\%$$
$$D\times E\times\frac{P_1}{14.7}=$$
$$1{,}500{,}000\times.644\times\frac{9.8}{14.7}=$$

643,000 cu. ft. Actual delivery
.643 × 86 = 55.3 I. H. P.

$$\frac{643{,}000}{828{,}000}=77.6\%$$

4. Adiabatic Solution

P_1 = 10" vac = 9.8 lbs. Absolute
P_2 = 44.7 lbs. Absolute

$$E=1-C\left[\left(\frac{P_2}{P_1}\right)^{1/N}-1\right]$$

N = 1.3
H.P. per 1000M = 86 (Weymouth)

Cylinder A,—5% Clearance

$$E=1-.05\left[\left(\frac{44.7}{9.8}\right)^{1/1.3}-1\right]$$
$$=1-.05\ (3.21-1)$$
$$=1-.1105$$
$$=.8895=88.95\%$$
$$D\times E\times\frac{P_1}{14.7}=$$
$$1{,}500{,}000\times.8895\times\frac{9.8}{14.7}=$$

890,000 cu. ft. Actual delivery
.890 × 86 = 76.5 I. H. P.

Cylinder B,—10% Clearance

$$E=1-.10\left[\left(\frac{44.7}{9.8}\right)^{1/1.3}-1\right]$$
$$=1-.10\ (3.21-1)$$
$$=1-.221$$
$$=.779=77.9\%$$
$$D\times E\times\frac{P_1}{14.7}=$$

$$1{,}500{,}000 \times .779 \times \frac{9.8}{14.7} =$$

773,000 cu. ft. Actual delivery

$$.773 \times 86 = 66.5 \text{ I. H. P.}$$

$$\frac{773{,}000}{890{,}000} = 87.0\%$$

What Solutions Show

The first solution (isothermal) when P_1=14.7 lb. absolute shows that an increase in clearance from 5 per cent to 10 per cent decreases the volumetric efficiency from 89.9 per cent to 79.8 per cent and that the capacity and horsepower with 10 per cent clearance is equal to 88.7 per cent of what they are with 5 per cent clearance.

The second solution (adiabatic) when P_1=14.7 lb. absolute shows that clearance does not decrease the adiabatic volumetric efficiency, capacity, and horsepower to the same degree as it decreases the isothermal values.

In both cases, (when clearance is 5 per cent and when it is 10 per cent) the adiabatic efficiencies, capacities and horsepowers are higher than the isothermal values and the adiabatic capacity with 10 per cent clearance is equal to 92.8 per cent of the capacity with 5 per cent clearance, whereas the isothermal ratio is, as stated above, only 88.7 per cent.

The third and fourth solutions when P_1=9.8 lb. absolute shows that as P_2/P_1 increases, the adiabatic values decrease much more slowly than do the isothermal.

If we take various values for P_2/P_1 and insert them in the isothermal and adiabatic formula, using values of C=4.4 per cent and C=10 per cent, and then plot curves from the results obtained we will get curves as shown in Figure 2.

Efficiencies obtained from the use of the isothermal equation are in all cases lower than those obtained from the adiabatic equation. Curve No. B shows the results of a test on a cylinder having 4.4 per cent clearance. Note how closely it

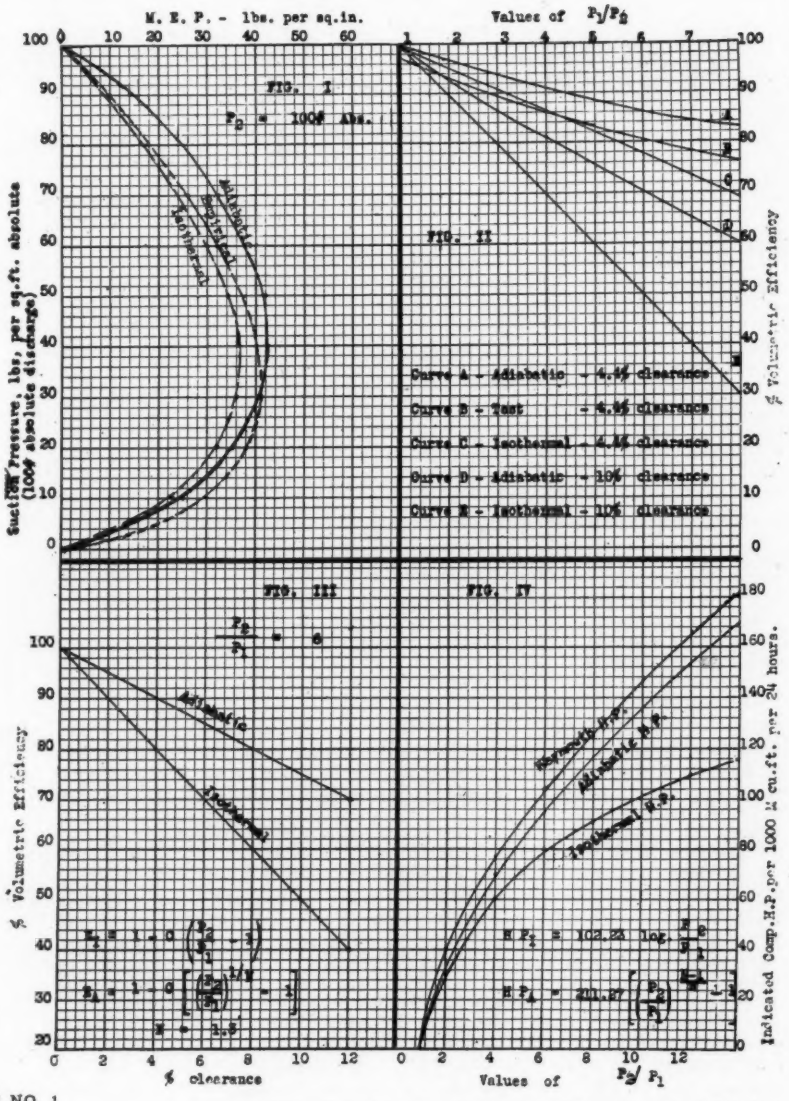

M. E. P. - lbs. per sq.in.
Values of P_2/P_1
FIG. I
P_2 = 100# Abs.
FIG. II
Curve A - Adiabatic - 4.4% clearance
Curve B - Test - 4.4% clearance
Curve C - Isothermal - 4.4% clearance
Curve D - Adiabatic - 10% clearance
Curve E - Isothermal - 10% clearance
Suction Pressure, lbs. per sq.ft. absolute (100# absolute discharge)
% Volumetric Efficiency
FIG. III
FIG. IV
$\frac{P_2}{P_1}$ = 6
Adiabatic
Isothermal
% Volumetric Efficiency
Indicated Comp. H.P. per 1000 # cu.ft. per 24 hours.
% clearance
Values of P_2/P_1

TABLE NO. 1

	5% Clearance		10% Clearance	
	P_2/P_1—3.02	P_2/P_1—4.56	P_2/P_1—3.02	P_2/P_1—4.56
Adiabatic Efficiency	93.30	88.95	86.60	77.90
Adiabatic Capacity	1,400,000	890,000	1,300,000	773,000
Isothermal Efficiency	89.90	82.80	79.80	64.40
Isothermal Capacity	1,350,000	828,000	1,197,000	643,000

agrees with the isothermal curve, particularly for values of P_2/P_1 lower than six, the range in which most of our compression work is done. The test from which this curve was plotted was recently performed according to the Air Compressor Manufacturer's standard. The volume of gas delivered was measured with an orifice meter as well as with a calibrated nozzle discharging into an expansion tank. Where the flow was steady the two methods checked within 1 per cent. The clearance volume of 4.4 per cent was determined by a water test. This test curve is lower than the theoretical isothermal curve where P_2/P_1 is less than 4.1, at which point it crosses and more rapidly deviates from the isothermal.

If we assume that P_2/P_1 is constant and equal to six and then plot curves of the results obtained through using various values of C, we get a curve as shown in Figure 3.

A study of Figures 2 and 3 show that while both the isothermal and adiabatic volumetric difficulties fall off rapidly with increased clearance as well as with increased values of P_2/P_1, the adiabatic efficiency falls off much more slowly than does the isothermal.

Figure No. 4 shows indicated compressor horsepower curves obtained from plotting the adiabatic and isothermal equations and Weymouth's empirical equation is

$$\text{H.P.} = 102.2\left[\frac{1.08 + \frac{1}{R^{2^2}}}{0.96 - 0.02R}\right] \log R$$

$$\text{Where } R = \frac{P_2}{P_1}$$

This curve shows that while the MEP is less than that of adiabatic compression when P_2/P_1 is greater than 3.2 (see Figure 1) the true horsepower is always greater than the adiabatic. The difference is due to such losses as those caused by slippage, valve friction, clearance, etc. The values taken from this curve should be increased by about 15 per cent to arrive at the brake horsepower of a direct driven unit.

The following comparison of horsepowers calculated as discussed herein with horsepowers measured from indicator cards will be of interest. The small differential in each case may be accounted for by the fact that ordinary pressure gauge readings were taken and used in deriving the calculated horsepower.

	Test 1	Test 2	Test 3	Test 4
Calculated h.p	91.4	85.0	87.5	89.5
Indicator card h.p.	94.2	89.0	91.3	91.0

In conclusion, the writer submits to the Association, the proposition that the isothermal volumetric efficiency more closely approaches the true volumetric efficiency than does the adiabatic; that this is particularly true over the range wherein the ratio P_2/P_1 is less than six; and that use of clyinder capacities based upon the isothermal volumetric efficiency in combination with Weymouth's empirical horsepower curve determines the true horsepower more accurately than does the use of either the isothermal or adiabatic horsepower equations.

Welding as Applied to Absorption Plants

By J. E. KOBERNICK

WHILE the subject of welding seemingly bears no direct relation to the manufacturers of gasoline, it does however associate itself with the construction of apparatus used for gasoline manufacture and a discussion ought not to be amiss. This is not a treatise covering all phases of welding and its application, but is merely brought up because of the vast difference in methods of welding, also quality and materials used

While the difference in practice is unfair to some who manufacture by the welding process, it ought at least to cause serious thought and investigation regarding methods and general practices of both those who are accomplishing successful welding, and particularly what test is given the work before it is released for use.

The quality of the plate used is a large factor when used for welding. Some makes of plates in tank quality show laminations and if a butt weld is made no very serious impairment of the seam is experienced, but if a lap joint is made, then only the thickness of the lamination can represent the strength of the seam. The use of the butt weld joint is therefore advisable.

While various practices are pursued the logical procedure is to prepare the plate for welding by beveling to about sixty degree angle. Longitudinal seams in circular shells are tacked at one end and spread on the other end. Practice alone determines the amount of spread necessary. The open end is held by a clamp which is released from time to time and retightened as the welding proceeds and continues to draw the seams together. Up to one half inch thickness of plate a single weld is used in the above manner with current values not to exceed 250 amperes and in thickness over one half inch plate the first bead is usually made nearly the thickness of the cross section of the plate and then an additional weld made over that. The second weld anneals and relieves the first weld of most strains.

The round about seams joining two circular sections are also prepared by beveling and the sections tacked in place. A filler bead is run, usually three quarters of the section of the area of the plate. This filler bead is then thoroughly cleaned, inspected for checks, and the final bead is put on for a finish. This final bead also anneals and relieves the filler bead of most strains.

Tubes should be cleaned by grinding or sand blast. The tube sheet should be counter-sunk and before any welding is done the whole job should be cleaned of any possible grease, which is easily accomplished by the use of an oxy-acetylene torch. This latter point holds true of any job as grease or oil on the surface to be welded is very detrimental to good welding by arc methods.

Rod for arc welding is a fairly important factor; only the best can assure good results. The large failure to standardize on rod is due to the fact that the selection of rod is left up to the welder himself. Good rod is of little use in a poor operator's hands and a poor rod is not the thing to give a good operator, consequently a good rod and a good operator is the ideal combination.

Good rod is determined by analysis only. We have seen operators use rod and kick because they claimed it to be no good. The lot was laid aside and fresh batch supplied, which according to the operator proved O.K. At a later time, while the man had his hood on and could not see, the rod in his holder was removed and the previously condemned rod substituted. He kept right on welding and when asked how the rod was behaving, he answered "Fine."

Periodical test pieces should be made by each welder and tested by some reliable firm who will give exact results. The amperage and voltage should be recorded while the test piece is made. If the amperage and voltage are correct for ordinary purposes and the weld failed at too low a factor, the operator used too long or too short an arc, either oxidized his deposit or failed to fuse it in.

The large trouble with manufacturers today is, "How many feet can a man do in a given time," instead of "How many feet can a man do good." Let us grant that a man can do as many feet good as he can just plain do, if you crowd him to a point where nervousness takes hold, he will unconsciously begin to just "do."

Testing the work is the prime essential which safeguards the purchaser. Due to the fact that a good weld well done and a good-looking weld poorly done look very similar, a rigid test materially higher than used where factors or shear, etc., are definitely known, must be applied. In no case should it be less than twice the working pressure, and in order to discover any possible defects the seams should be violently hammered with a four or six pound hammer, hard enough to mark the welding at intervals of about twelve inches while the full test pressure is on.

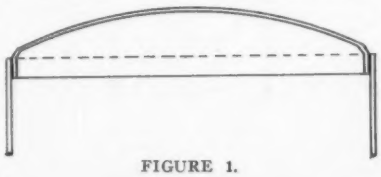


FIGURE 1.

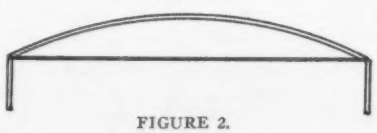


FIGURE 2.

When the above precautions have been taken and the vessel has been properly designed with a safety factor of not less than five, after allowing 85 per cent for the seams, experience has shown that it is not only equal to rivets, but is far superior, as a job once done is always done.

In conducting tensile tests, an average of 49,500 pounds per square inch with a low of 48,000 pounds should be expected, and when the proper combinations are brought together you will get them.

The fatigue of the weld and the metal adjacent to the weld has been much discussed and some very interesting data is available concerning this phase. The Westinghouse Electric Company have conducted the exhaustive experiments along this line and have circulars out illustrating the results found.

In regard to failure of welded apparatus, we recall to mind one particular instance where a vessel failed and we inquired as to the dimensions of the vessel, thickness of plate used, shape and method of welding. We found an 84-inch diameter pressure vessel built of 3/16-inch plate with a very flat 5/16-inch head, but welded on. While a thirty pound pressure would not seem excessive, yet for a small additional cost, a heavier shell could have been procured, the head given a standard dish, and undoubtedly the vessel would not have failed. While we are not attempting to find fault, we must say that the shell was too thin and that the head was not dished properly, by this we mean, were the head prepared for riveting, a flange would have caused the head to assume the shape of Figure 1, but where is was left as in Figure 2 with a possible flat edge, why blame the weld if the weave in the head caused numberless movements in this shell and finally a rupture?

The testing of men must of necessity be by trial. This can be accomplished by giving him a piece of metal to weld, having the foreman observe the work, and then testing the work by bending or otherwise.

In making the use of arc welding a success it is wise to employ the services of a welding engineer. This man should be a practical operator on all kinds of welding, be a technical graduate who has been trained to use the correct welding process where it is most suitable. Full authority should be given him as to design, material and process used as well as supervision of personnel, whether direct or through competent assistants.

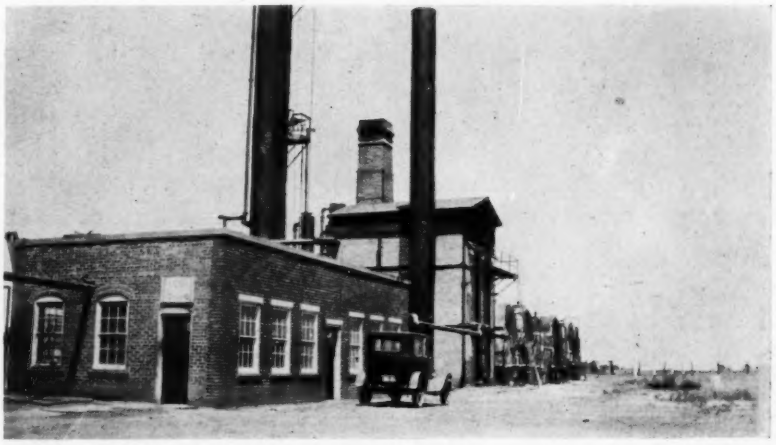
In closing we will say that tests by the General Electric and Westinghouse Electric Companies have been made covering almost every phase of arc welding and records show welding to withstand fatigue that riveted joints can never endure.

New Tube Still and Bubble Tower Improves Plant Operation

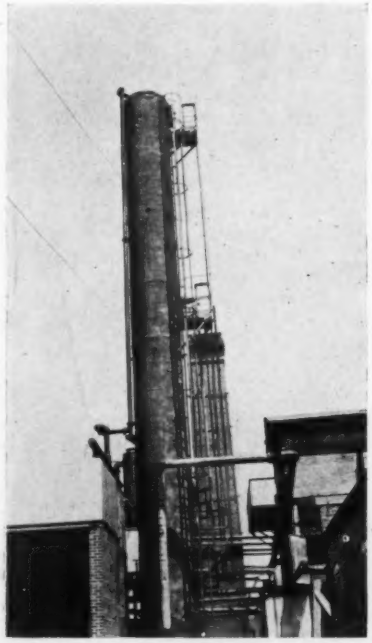
By RALPH E. GOODE

ECONOMICAL operation of the plant with the utmost in realization in yields from crude throughput is perhaps a matter of greater importance to the small refiner at this time than at any other in the history of the refining industry. As an outstanding example of what may be achieved in this respect, especially among the small plants in the Mid-Continent territory, the 2500-barrel refinery of the Primrose Refining Company located in Wichita Falls with its new installation of tube still and bubble tower of the Widdell type, stands as a sound and economical investment, giving returns that more than justify the financial outlay. The Primrose plant originally, at the time of the first installations during the high production period of the Burkburnett oil field, was started as one of a chain of the Davis' One Man Refineries, the Primrose Company taking it over, however, and adding new equipment and improvements and operating it since that time. Construction of the new tube still with a five-foot by 68-foot bubble tower, was started during the latter part of 1926 and completed in February, 1927.

The entire plant is one of the best arranged refineries to be found in this district. The office and other buildings are all of the best red brick construction and the refinery yard is protected by a layer of gravel.



VIEW OF PRIMROSE REFINING COMPANY PLANT AT WICHITA FALLS. NEW TUBE STILL RECENTLY INSTALLED IN CENTER OF ILLUSTRATION. NOTE CONSTRUCTION OF BUILDINGS AND PLANT YARD COVERED WITH LAYERS OF GRAVEL.



VIEW OF FRACTIONATING EQUIPMENT USED IN CONJUNCTION WITH TUBE STILL FROM WHICH FOUR STREAMS ARE REMOVED. TOWER IS 5 FEET BY 68 FEET IN DIMENSIONS.

The plant receives its charging stock as a general mixture of North Texas crude, the gravity running around 36.0. Before the installation of the tube still the crude was skimmed through four 250-barrel shell stills operating as continuous, hooked up to baffled towers four feet by 20 feet with six-inch vapor lines to regular box condensers. These stills operate now in connection with the tube still, either as continuous or as batch, which is the present method.

Gas for Fuel

Firing of the stills, up until the early part of this year, was done with fuel oil residuum, as was the case with most of the North Texas refineries, but on completion of the industrial gas line from the Panhandle oil field, gas burners were installed and the gas is now used exclusively. The Webster fuel oil burners were left as they were in case an emergency should arise. The gas burners are of the Perfecto type. The steam power comes from two 125 H.P. horizontal return tubular boilers operating under an average steam pressure of 80 pounds. They are fired through Webster oil and gas burners.

All storage tanks and agitators, excepting the crude oil tanks, are painted with aluminum white paint for the reduction of evaporation losses. The Primrose refinery products are "New Navy" gasoline, with some 64/66-374 end point. Most of this is exported along with kerosene. The fuel oil and gas oil is marketed locally.

Construction of Tube Still

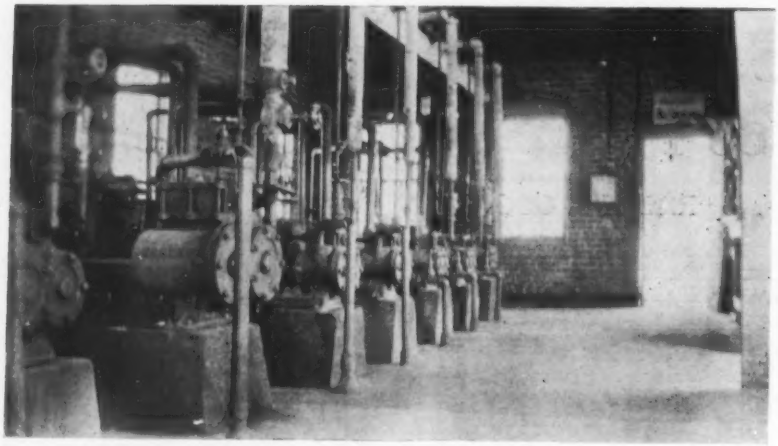
Since the installation of the tube still with the specially designed bubble tower, the plant has increased the percentage yield considerably and cuts are made wherever desired. The general plan of construction of the tube still consists of 120 tubes opening sideways with the furnace. There are 26 three-inch tubes in the roof element 18 feet long and 94 four-inch tubes in the lower bank 14 feet long, all equipped with cast steel return bends. The construction of the furnace is such that direct flame contact with the tubes is avoided. Heat absorption is effected by means of specially designed fans near the furnace stack.

One of the outstanding features of this type of tube still is the ease with which inspection and clean-outs may be made. The inside of the still is easily reached and weak tubes or furnace walls may be readily spotted and repaired, and tube rattling can be done in a fraction of the time ordinarily required.

Brown recording instruments are used exclusively in connection with the still for temperature control work.

Four Streams From Bubble Tower

The bubble tower in connection with the tube still is an insulated tower five feet by 68 feet in height, with three liquid levels. There are 25 trays in this tower with 32 bubble caps on each tray. At each liquid level there is a manhole and platform at the ladder side. A six-inch vapor line extends from the top of the tower to the condensing coils; the gasoline vapors being removed at this point. Four streams are removed from the tower. The fuel oil bottoms consisting of 36 per cent of the crude, allowing for 2 per cent distillation loss, are taken from the bottom of the tower. The gas-oil, consisting of 8



INTERIOR OF MAIN PUMP HOUSE AT PRIMROSE REFINERY, WICHITA FALLS, TEXAS.

per cent with a gravity of 31/32, is next removed, then 8 per cent of 41/42 gravity kerosene, and then the gasoline consisting of 46 per cent of "navy," is removed, resulting in a total recovery above the fuel oil of 62 per cent from the crude. This is accomplished under ordinary methods of operation, although by means of cracking the still may be made to yield 8 to 10 per cent more gasoline.

Mr. Munsey, the plant superintendent, states that it is not preferable to allow cracking to take place with the company's plan of operation. Several methods have been tried out experimentally with this type of still, resulting in greatly increasing the yield through cracking by increasing the pressure and forcing the temperature upward and allowing more time for heat contact with the oil.

The plan of operation at this time consists of bringing the charging stock first through a system of heat exchangers, raising the temperature to 325 degrees F. at the time of entering the still and carrying it through and out at approximately 650 degrees F. The gasoline yield through the lines at the look box has an average temperature of 80 degrees F. and an initial boiling point of 126 degrees F.

The initial boiling point on the fuel oil is approximately 476 degrees F. with about 4 per cent over at 500 degrees F. With this type of tower the "negative" point is very close, averaging between cuts about eight to 10 degrees F. The gasoline and kerosene is easily treated in batch agitators, sweetening of the gasoline is effected with doctor, while the kerosene is given an acid wash followed with doctor solution treatment.

Plant Closed

Los Angeles.—The Standard Gasoline Company reports shutting down its absorption gasoline plant, Santa Fe No. 3, during the latter part of May. The gas formerly treated by this plant is now being handled through Santa Fe No. 6. No announcement was made relative the future use of the equipment formerly in service at the No. 3 plant.

Catalysers and Their Effects Upon the Oxidation of Mineral Oils

(Continued from page 61)

all four cases mentioned under (A) the temperature and time were kept constant. The amounts of reduced copper used were 10, 20 and 80 grams per liter of oil. The results obtained showed that there was no appreciable difference in the amount of solid substances formed. Therefore, it may be concluded that 10 grams of the catalyst per liter of oil will cause the same action as 80 grams per liter of the catalyst.

(E)—Presence and Absence of Sunlight

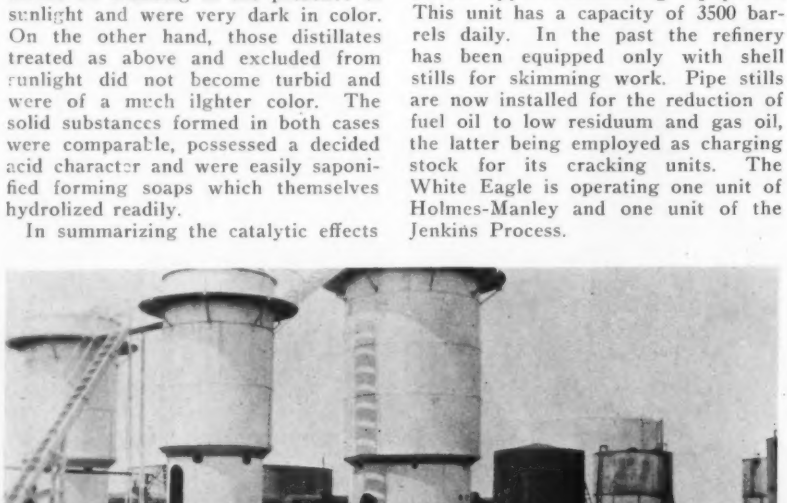
The distillates oxidized with air in the presence of the catalyst became turbid on standing in the presence of sunlight and were very dark in color. On the other hand, those distillates treated as above and excluded from sunlight did not become turbid and were of a much lighter color. The solid substances formed in both cases were comparable, possessed a decided acid character and were easily saponified forming soaps which themselves hydrolized readily.

In summarizing the catalytic effects upon the oxidation of mineral oils the following points were noted:

1. Catalysts speed up the oxidation of mineral oils.
2. Low temperatures caused the formation of highly viscous residues.
3. High temperatures cause the formation of solid coky residues the speed of reaction of which is directly proportional to the increase in temperature.
4. The percentages by weight of solid substance formed is directly proportional to the increase in time of oxidation.
5. By increasing the amount of catalyst no increase in the amount of solid residues was noticed.
6. Oxidation takes place readily in both cracked and uncracked distillates.
7. Catalytic oxidation has a marked effect on the sulphonation of mineral oils relative to their iodine addition and substitution values.
8. Reduced copper proved to be the most effective catalyst used in this work.
9. Presence of sunlight caused the oils to become turbid and to darken.
10. The solid residues formed by oxidizing mineral oils in the presence of catalysts were of an acid character and therefore proved to be undesirable.

White Eagle Adds Stills At Casper

Casper, Wyo.—Among the improvements recently installed by the White Eagle Oil and Refining Company here, is a new tubular distillation unit and bubble type fractionating equipment. This unit has a capacity of 3500 barrels daily. In the past the refinery has been equipped only with shell stills for skimming work. Pipe stills are now installed for the reduction of fuel oil to low residuum and gas oil, the latter being employed as charging stock for its cracking units. The White Eagle is operating one unit of Holmes-Manley and one unit of the Jenkins Process.



AGITATOR ASSEMBLY LOCATED A SAFE DISTANCE FROM REFINERY PROPER. EQUIPMENT USED FOR SWEETENING GASOLINE AND KEROSENE.

Low Boiling Products Cracked From Parrafin*

Hard, white material yields volatile oils when heated to boiling in presence of activated charcoal at atmospheric pressure

IT is not only a matter of scientific interest but also of technical importance to determine whether or not the high molecular weight saturated hydrocarbons, which are charaterized as being very stable, can be decomposed, that is split, into lower boiling ingredients and also under what conditions this phenomenon takes place. In the first place it is necessary to select a well-defined material as the starting point in this investigation. Hence the author thought best to choose solid, white, hard paraffin, which remains so at the ordinary room temperature and which has a melting point varying between 50 and 52 degrees C. The splitting or decomposition of the paraffin wax was accomplished in an apparatus which is shown in the accompanying illustration.

In this apparatus as in the splitting apparatus proper which is provided with an inlet and an outlet. This splitting apparatus is placed in a metallic bath for the purpose of obtaining better distribution of the heat and also for the purpose of avoiding local overheating. The splitting apparatus is hung in this metallic bath. The metallic bath is heated by electrical means as may be seen at "C", or else it may be heated with gas. The catalyst, which is for example activated charcoal, is placed in the basket "D" which is made so that it can be rotated during the experiment. The molten paraffin is shown at "E" and "F" is the cylindrical steaming dome, while "G" is a reflux condenser which is provided with a test cock. This condenser may be either air or water cooled. The cooler for the distillate is shown at "H" and "I" is collecting vessel for the distillate. Metallic wells are arranged at various points for the purpose of measuring the temperature.

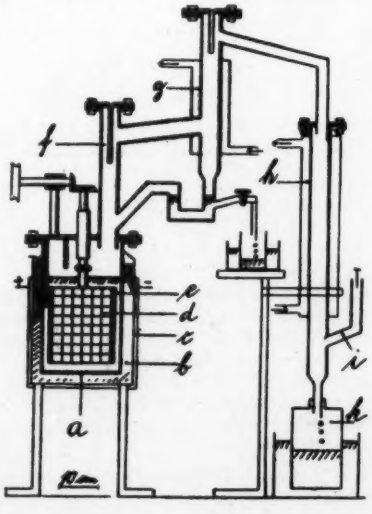
Starting Process

The starting material for the experiment is four thousand gram of a pure hard paraffin of 50 to 52 degrees C melting point, and the catalyst is 670 grams of activated charcoal made by F. Bayer & Company, of Leverkusen, Germany. The heating of the apparatus lasts for about one hour. The distilling period lasts approximately 42 hours without interruption. The temperature of the metallic bath during the experiment amounted to 315 to 450 degrees C and the temperature of the liquid about 300 to 400 degrees C. The pressure was maintained at atmosphere. Three distillates were collected during the progress of the experiment. The first distillate amounted to 930 grams with a specific weight of 0.746 at a temperature of 20 degrees C; the second distillate weighed 945 grams and had a specific gravity of 0.766 at a temperature of 20 degrees C; the third distillate amounted to 960 grams, with a specific weight of 0.786 at a temperature of 20 degrees C. The total distillate amounted to 2835 grams of an average specific gravity of 0.766 at a temperature or 20 degrees C. The results of the experiment can be summed up in the following manner.

The total weight of distillate, 2835 grams, amounted to 70.8 per cent of the original weight of 400 grams of hard paraffin. The residue that remained in the cracking apparatus and catalyst amounted to 601 grams of 15.1 percent of the original weight of paraffin. The waste gases and the other losses amounted to 564 grams or 14.1 percent of the total original weight. The sum of all htese figures makes 400 grams or 100 per cent.

Results

The results show that the specific gravity of the distillate increases, as the distillation test progressed. The conclusion can therefore be drawn that the lower boiling ingredients of the paraffin yield smaller and hence lower boiling and lighter splitting fractions, while the higher boiling ingredents of the paraffn yield greater and hence higher boiling and heavier splitting fractions. The fresh distillate was water-white. One hundred cubic centimeters of the total distillate were taken for the purpose of determining the distillation, this quantity of distillate being subjected to a regular Engler distillation. The results of this test are given in the following tabulation.



ENGLER DISTILLATION.

Temp. degrees C. Beginning	Vol percent	Temp. degrees C. till	Vol. percent
45	0	230	58
ill 60	1	240	61
70	4	250	64
80	7	260	68
90	10	270	71
100	14	280	74
110	18	290	77
120	22	300	80
130	25	310	82
140	28	320	84
150	32	330	87
160	35	340	89
170	37	350	91
180	41	360	93
190	44	365	94
200	48	After run 4% paraffin residue	96
210	51		100
220	54		

Then again one thousand grams of the total distillate were subjected to a fractional distillation and the results of this test are given in one of the following tabulations. Glass flasks were not used for the purpose of distilling large quantities of gasoline, but round copper vessels, or better round aluminum vessels, which hold up well in usag.

COMPOSITION OF THE TOTAL DISTILLATE.

PRODUCT.	Percentage composition of the distillate in percentage	Yield figured on the original material, 4000 grams of paraffine
1. Light benzine, 45 to 150 degrees C B. P.	31	22.0
2. Heavy benzine 150 to 200 degrees C B.P.	19	13.4
3. Petroleum, 210 to 300 degrees C B.P.	30	21.2
4. Residue, gas oil, over 300 degrees C B.P.	20	14.2
	100	70.8

Th residue which was left behind in the kettle was allowed to run out. The residue that was absorbed in the catalyst was extracted with the aid of gasoline and the latter was then evaporated. The remaining total residue amounted to 601 grams and consists half of undecomposed paraffin and half of a slightly yellowish oil, a sort of lubricating oil, of 0.890 specific gravity. The composition of the residue figured on the original weight of four thousand grams of paraffin was 7.6 percent of undecomposed paraffin and 7.5 percent of lubricating oil, which made a total yield of 14.1 percent.

Recombination

It can be concluded from the fact

*Translated by Ismar Ginsberg from paper by H. Herbst, Zeit. f. adgew, Chemie, 1926, 194.6.

that a lubricating oil was formed that in the splitting of paraffin there are formed not only individual decomposed substances, but also that these split products combine together again and polymerize to give products of higher molecular weight. While paraffin consists principally of high molecular weight hydrocarbons which have 19 to 32 and even more carbon atoms, lower members of the hydrocarbon series C_nH_{2n+2} were formed again during the splitting process. It is these hydrocarbons which form the principal portion of the distillate. In addition thereto, however, unsaturated compounds of the C_nH_{2n} series, as well as the saturated naphthenes, are also formed. The increase in the boiling point of the distillate is an exceedingly regular one so that the fuel should give very good results in the internal combustion engine.

The gases, that is waste gases, that are evolved during the splitting process and which amount to 14.1 percent of the original paraffin employed, have been analyzed and the figures are given in the following tabulation.

	Percent by Vol.
1. Carbon dioxide	3.4
2. Hydrocarbons of the CnH2n series	15.6
3. Oxygen	1.0
4. Carbon monoxide	6.0
5. Hydrogen	25.4
6. Methane	48.0
7. Nitrogen	0.6

Thus the waste gas consists of about 50 per cent methane and 25 percent of hydrogen and of about one sixth of hydrocarbons of the C_nH_{2n} series.

Summary

The results of the investigation may now be summarized. It has been seen that the splitting of hard paraffin by heating with activated charcoal yields about 22 percent of light benzine, boiling between 45 to 150 degrees C and 13.4 percent of heavy benzine which boils between 150 and 210 degrees C. Thus the yields of both of these products are considerable. This conclusion must be reached particularly when consideration is paid to the fact that most crude petroleums will give only four to 20 per cent of light benzine on distillation. The splitting activity of the activated charcoal is very favorable and the productivity and lasting qualities of this catalyst are several times that of oher basic or acid catalysts. The high productivity of the catalyst rests on the fact that acivated charcoal posesses a very high degree of adsorption, which is not reached by any other materials and that activated carbon is furthermore able to form a labile adsorption compound with the material that is adsorbed. Activated charcoal is also particularly well suited for continuous operations for the splitting capacity of the material is not noticeably affeced by long enduring and repeated use. It is worthy of mention that no coking and no formation of asphlatic substances took place during the splitting process. Another important characteristic and advantage of the splitting process is hat a temperature approaching incandescence need not be employed. This then means that the formation of coke is avoided, a phenomenon which often happens in the splitting of mineral oils by the various cracking processes which are used to day. Great disadvantages are connected with the formation of coke, for this product, as is well known, adheres very tenaciously to the walls of the cracking vessel with the result that the cracking stills will las for few operations only.

The yield of gasoline can however be increased to a certaiin degree when the gas oil fraction, which boils above a temperature of 300 degrees C, and which amounts to 14.2 per cent of the total distillate, is subjected to addiional cracking. The following yields can then be obtained from this substance.

	Per Cent.
1. Light benzine, up to 150 degrees C boiling point	3.12
2. Heavy benzine from 150 to 210 degrees C boiling point	1.90
3. Petroleum from 210 to 300 degrees degrees C boiling point	3.01
4. Gas oil over 300 degrees C boiling point	2.02
5. Residue: paraffin-containing spindle oil	2.14
6. Waste gases and losses	2.01
Total	14.20

When the operation is carried out, mroeover, in a continuous manner then the 7.6 percent of the undecomposed paraffin, which is found in the still residue, is further decomposed and the following yield is obtained.

	Per Cent.
1. Light benzine, up to 150 degrees C boiling point	1.67
2. Heavy benzine, 150 to 210 degrees C boiling point	1.02
3. Petroleum, 210 to 300 degrees C boiling point	1.61
4. Gas oil over 300 degrees C boiling point	1.08
5. Residue: paraffin-containing spindle oil	1.15
6. Waste gases and losses	1.07
Totals	7.6

If the continuous operations is further carried out and the portion of the distillate, obtained above, and boiling over a temperature of 300 degrees C is again cracked, then the final yields of various products obtained in the splitting of paraffin with the aid of activated charcoal are given in the following tabulation.

	Per Cent.
1. Light benzine up to 150 degrees C boiling point	26.79
2. Heavy benzine, 150 to 210 degrees C boiling point	16.32
3. Petroleum, 210 to 300 degrees C boiling point	25.82
4. Gas oil, over 300 degrees C boiling point	3.10
5. Residue: paraffin-containing spindle oil	10.79
6. Waste gases and losses	17.18

It is thus easy to see that a very good yield of low boiling point ingredients are obtained. The particular advantage of this cracking process rests in the fact that it is carried out at ordinary low atmospheric pressure. This means that it is not necessary to provide complicated and costly high pressure apparatus. The process can also be applied to other organic substances, such as mineral oils in particular, high boiling point mineral oil residuals, tars, ozocerite and the like.

The splitting temperature lies between 300 and 450 degrees C and the principal cracking temperature between 350 and 400 degrees C, so that it is possible to decompose substances whose boiling points lie between these limits or are higher, without there being any special difficulty at all. The process itself, which takes place with the consumption of heat, is a relatively slow decomposition which is favorably affected by the presence of activated charcoal.

If it is desired to crack substances whose boiling temperatures lie under 300 degrees C, then it is not generally possible to carry out the operation at the ordinary atmospheric pressure, for under these conditions these substances will pass over either only slightly decomposed or not at all. It is known that in boiling high molecular weight organic compounds, which boil over 300 degrees C, a slight decomposition will most always set in. Low molecular weight substances, which boil under 300 degrees C, generally do not decompose on boiling or to a slight degree only. The way in which to use this splitting process with activated charcoal for these substances is to increase the pressure above amosphere. Pressures of 10 to 25 atmospheres have been found satisfactory.

Plant Operating

Los Angeles.—The new absorption gasoline plant recently constructed at Huntington Beach by the Standard Oil Company of California and known as Huntington Beach No. 8, was placed in operation during the last month, with G. S. Laros as plant manager. Mr. Laros is a graduate of the company's training school.

Plan New Plant

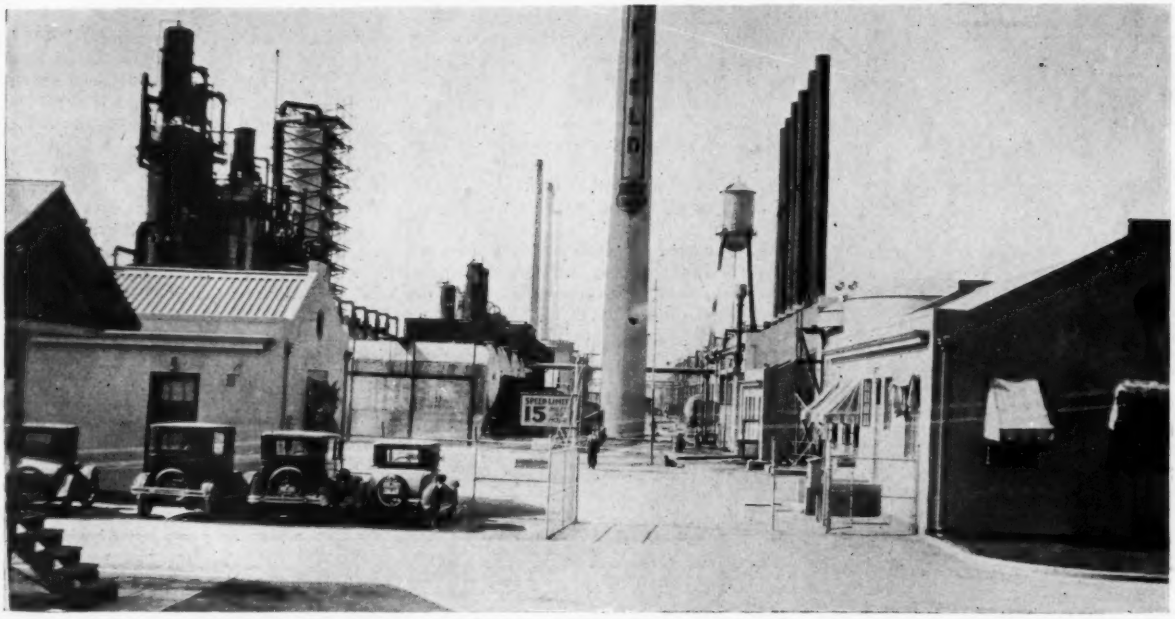
Los Angeles.—The Standard Engineering Company of this city, operators of several high pressure gasoline plants, which extract commercial gasoline in profitable quantities from so-called dry or domestic gas, is planning the erection of a $40,000 gasoline absorption plant in the Alamitos Heights district at an early date.

Add to Canadian Refinery

Chatham, Ont.—Canadian Oil Refineries, Ltd., operating a refinery at Petrolia, Ontario, is improving the plant operation by the addition of enlargements to the filtering plant and the installation of additional drum testing and cleaning equipment.

Erecting Refinery

Gainesville, Texas.—The H. & H. Fuel Company early in July began the construction of a small refining plant just south of Muenster in Cooke County. The plant will operate on crude oil from the newly open pool on the Ruwaldt lease, for which oil the company agreed to pay a 15 cent premium.



VIEW OF THE RICHFIELD OIL COMPANY'S HAYNES, CAL., REFINERY. NOTE THE COMPACTNESS OF DESIGN AND CONSTRUCTION OF THIS PLANT, THROUGH WHICH 45,000 BARRELS OF CRUDE ARE RUN DAILY WITH A TOTAL OPERATING FORCE OF LESS THAN 100 MEN.

Small Crew Operates Efficient Richfield Refinery

Daily capacity of more than 45,000 barrels put through plant with operating force of less than 100 men

By BRAD MILLS
Staff Representative

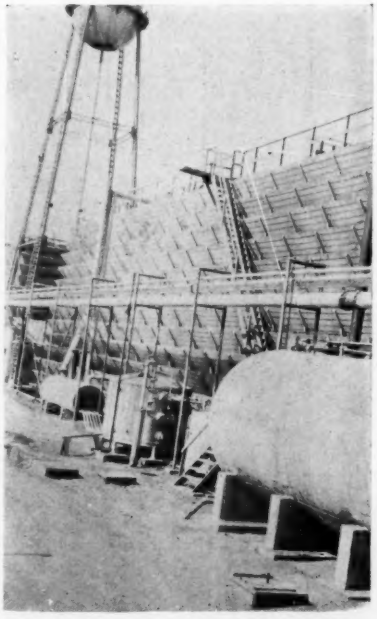
ATTENTION has been attracted by a recent report that the Richfield Oil Company was running 35,000 barrels of crude at its Rioco refinery, near Los Angeles, with a force of less than 100 men.

Much comment has resulted and the writer has personally contacted the refinery superintendent, R. A. Panero, and the company's refinery engineer, David E. Day, in an effort to learn the details of operation of this remarkable plant.

When the Richfield refinery was built much publicity was given to it because of its compactness, its independence of outside requirements and its improved equipment. The natural result should have been a comparatively small payroll, but this fact was not stressed until long after the plant was in operation. In other words, it was so obvious that it was overlooked at the time.

When thinking of a refinery with a capacity of almost 50,000 barrels, it has long been the custom to picture a force of perhaps 1000 men—or even more—and the fact that the Richfield Oil Company is actually running above 45,000 barrels of California crude with less than 100 men, causes the average reader to wonder how such an accomplishment is possible.

The opinion exists among many that the refinery is running only one shift.



SHOWING THE TWO LARGE WATER COOLING LOUVRE TOWERS—WITH THE COMPANY'S OWN WATER TANK ERECTED ON THE PLANT SITE

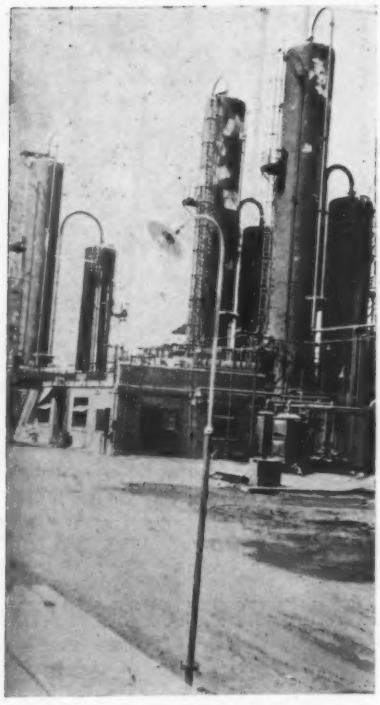
Some are of the opinion that two shifts of 12 hours are in force; while others conclude from the number of men employed that "something must be wrong."

As a matter of fact, the plant is running full 24 hours each day. All work is based on eight-hour shifts and there is no "joker" to be found. The refinery is equipped to carry the crude as far as the average California plant, which is operated by other large corporations. Lubricating stocks are not being made but gasoline, kerosene, gas oil and fuel oils are being made at present. The refinery was running around 35,000 barrels when general interest was first aroused, and about 85 men were employed. The increase to 46,000 barrels was accompanied by the addition of only 12 or 14 men.

Labor Saving Devices

As an example of the labor-saving devices installed in the refinery, it is noteworthy to mention that one man can control the operation of an entire refining unit without leaving the receiving house. The indicating and recording thermometers, pressure gauges and pyrometers are located on one centrally placed instrument board for the convenience of the operator.

The steam generating plant has been placed in a central location and the six Foster marine type boilers, developing



THE CROSS CRACKING UNIT INSTALLATION AT RICHFIELD'S HYNES REFINERY—A TOTAL CAPACITY OF 8000 BARRELS.

more than 1800 horsepower, are attended by only one man. The power unit is a very large one and corresponds favorably with many operated by as many as six men.

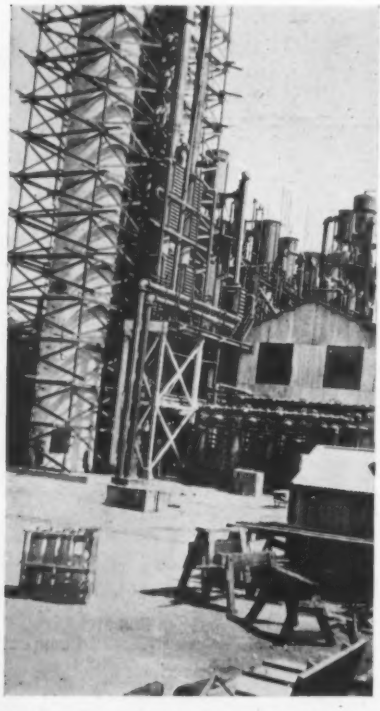
A total of four Cross cracking units have been installed. One superintendent and 13 operators are successfully handling the work on these units. Foster type heating elements and furnaces are used. These cracking units have a combined capacity of 8000 barrels.

The skimming plant requires the bulk of the labor, a total of 65 men now being employed. The number is subject to constant change as the maintenance department requirements vary somewhat. The company recently added a 10,000 barrels unit to the plant but the number of men was increased by only seven or eight. The personnel of the skimming plant includes a superintendent, his assistant, three stillmen and six helpers, five electricians, three firemen and three helpers, seven pumpers, seven treating plant men, two loaders, one gauger, approximately 20 maintenance men, one shipping foreman, one chemist, his assistant and three laboratory men.

It is remarkable to note that the shipping department, the personnel of which was enumerated above, consists of only one or two loaders besides the foreman and the gauger. The shipments from the plant are enormous, yet are in the hands of a very few men.

A very complete gas recovery absorption plant is operated by one foremen and only three operators. It is specially designed, very effective and has a high recovery efficiency.

Not more than 10 men are employed in a general capacity about this plant. Four men regularly are employed as clerks in the office, one man serves in a utility capacity, one truck driver suffices and other help includes a messenger and a combination janitor and gardener. The office force probably is the smallest of any refinery in the world running as much crude. There also seems to be no place for men who have no particular work to perform.



REAR VIEW OF THE DISTILLATION UNIT SHOWING FRACTIONATION AND CONDENSING EQUIPMENT.

STANDARD TABLE OF SULPHURIC ACID EQUIVALENTS ADOPTED BY MANUFACTURING CHEMISTS ASSOCIATION

Degrees Baumé	Specific Gravity	Degrees Twadell	Per Cent of Sulphuric Acid H_2SO_4	Degrees Baumé	Specific Gravity	Degrees Twadell	Per Cent of Sulphuric Acid H_2SO_4
0	1.0000	0.0	0.00	37	1.3426	68.5	43.99
1	1.0069	1.4	1.02	38	1.3551	71.0	45.35
2	1.0140	2.8	2.08	39	1.3679	73.6	46.72
3	1.0211	4.2	3.13				
4	1.0284	5.7	4.21	40	1.3810	76.2	48.10
				41	1.3942	78.8	49.47
5	1.0357	7.1	5.28	42	1.4078	81.6	50.87
6	1.0432	8.6	6.37	43	1.4216	84.3	52.26
7	1.0507	10.1	7.45	44	1.4356	87.1	53.66
8	1.0584	11.7	8.55				
9	1.0662	13.2	9.66	45	1.4500	90.0	55.07
				46	1.4646	92.9	56.48
10	1.0741	14.8	10.77	47	1.4796	95.9	57.90
11	1.0821	16.4	11.89	48	1.4948	99.0	59.32
12	1.0902	18.0	13.01	49	1.5104	102.1	60.75
13	1.0985	19.7	14.13				
14	1.1069	21.4	15.25	50	1.5263	105.3	62.18
				51	1.5426	108.5	63.66
15	1.1154	23.1	16.38	52	1.5591	111.8	65.13
16	1.1240	24.8	17.53	53	1.5761	115.2	66.63
17	1.1328	26.6	18.71	54	1.5934	118.7	68.13
18	1.1417	28.3	19.89				
19	1.1508	30.2	21.07	55	1.6111	122.2	69.65
				56	1.6292	125.8	71.17
20	1.1600	32.0	22.25	57	1.6477	129.5	72.75
21	1.1694	33.9	23.43	58	1.6667	133.3	74.36
22	1.1789	35.8	24.61	59	1.6860	137.2	75.99
23	1.1885	37.7	25.81				
24	1.1983	39.7	27.03	60	1.7059	141.2	77.67
				61	1.7262	145.2	79.43
25	1.2083	41.7	28.28	62	1.7470	149.4	81.30
26	1.2185	43.7	29.53	63	1.7683	153.7	83.34
27	1.2288	45.8	30.79	64	1.7901	158.0	85.66
28	1.2393	47.9	32.05				
29	1.2500	50.0	33.33	64¼	1.7957	159.1	86.33
				64½	1.8012	160.2	87.04
30	1.2609	52.2	34.63	64¾	1.8068	161.4	87.81
31	1.2719	54.4	35.93	65	1.8125	162.5	88.65
32	1.2832	56.6	37.26	65¼	1.8182	163.6	89.55
33	1.2946	58.9	38.58				
34	1.3063	61.3	39.92	65½	1.8239	164.8	90.60
				65¾	1.8297	165.9	91.80
35	1.3182	63.6	41.27	66	1.8354	167.1	93.19
36	1.3303	66.1	42.63				

Vapor Stage Water Bath Lessens Corrosive Action

PANHANDLE crude oil shipped by tank car to Texas City is charged to stills at the rate of 2500 barrels daily at the refining plant of the Terminal Oil & Refining Company, Houston, Texas. This plant was designed and constructed five years ago for operation on heavy crudes, especially such oils as Panuco from Mexico and Smackover crude from Southern Arkansas. In addition to successful operation with these types of low gravity crudes, 12 and 18 degrees A. P. I. gravity, the plant has also at various periods charged such light oils as North Texas production, and now operates on Panhandle oils. This ability to switch from light to heavy crudes without involving any change in equipment and process points to a certain elasticity of design and layout.

Another feature of interest in this connection lies in the fact that although the various heavy grades of crude oils including Gulf Coast, Mexico, Smackover and Panhandle are all classified as high sulphur content charging stocks, and therefore difficult to handle from the standpoint of corrosive tendencies, the plant equipment shows but little indication of any material damage along these lines. This statement does not mean that there is no corrosion of metal parts about the plant, but indicates that the corrosion problem is so far of no greater magnitude than the same problem as it occurs among those refineries operating on the lighter crudes, such as North Texas and many Oklahoma oils, where sulphur content of the crude is much less than the percentage of this substance as found in the crudes upon which the plant has been working.

The arrangement of equipment and the operation process is a little different from tha tusually occurring with skimming plants. The stills are charged with a Worthington 10x6x10-inch duplex steam pump, discharging the cool oil into and through the shell type heat interchanger. From this device the crude is conducted through a pipe still type preheater. Charging Panhandle crude this operation, and including the temperature increase developed in No. 1 shell still, where the oil is distiled at about 375 degrees Fahrenheit, effects the removal of those vapors constituting the light gasoline cut or fraction. There are three shell stills, each 10 by 30 feet, and two of the pipe still type preheaters. Following the crude flow line from No. 1 shell still where the lighter gasoline cut is removed, the oil is then conducted by gravity flow to the second shell still. At this point sufficient heat is applied to remove all of the remaining gasoline and this vapor stream is conducted to towers, condensed and stored as naphtha.

Following this heat treatment the remaining oil is removed from the second still by pump and conducted to the second of the pipe still type preheaters. Here the temperature of the oil is raised about 100 degrees F. and conducted to the third shell retort in the series. The plant makes no kerosene cut. The third shell still is fired at a temperature of about 650 degrees F., and the vapors removed to the condenser box direct without fractionation to be condensed as gas oil or heavy distillate. This material is employed as charging stock for the standard Jenkins cracking unit.

This cracking installation is shown in the accompanying illustrations. This unit is operating on gas oil charging stock derived from crude. The foregoing briefly describes the distillation process as applied at the plant. The use of the two preheaters results in greatly increased capacity, for it would be difficult to secure the present operation temperatures, especially the 650 degrees F. maintained in the third shell still, without the use of the intermediate heater of pipe still type. This equipment is incidental to operation on the heavier crudes which the plant at times charges. The distillation equipment and also the fractionation devices are illustrated in Figure 2 of the accompanying photographs.

Fractionation

The fractionation equipment includes two towers in series for each shell still. These towers are packed with metal scrap and in size are 6 by 15 feet. They are supported by aprons of the same material as is used in the tower construction. Following the sequence of distillation, the vapors derived from the first still are conducted through two towers in series. Reflux accumulating in the towers is returned to the still by back trap lines. All towers are of the recycle type. Gasoline vapors derived from the second crude still are also conducted through two towers. Operating the third shell retort for gas oil production eliminates the necessity of using towers at this stage of the procedure. All of the dephlegmation equipment is so manifolded and arranged that the vapors can be either directed into one of both of the towers provided, or it can be diverted to bypass the towers, as in the case of the third still making charging stock for the Jenkins units.

As was previously stated, all of the dephlegmation equipment installed at the plant is of the packed type, using metal scrap as the packing medium. After five years of operation on crudes of high sulphur content, a recent examination showed that other than a slight evidence of pitting, both the tower shells and the metallic packing material was in excellent condition and not damaged by corrosion. In addition to this condition prevalent with the tower equipment, the condenser coil equipment, which is the usual source of corrosion troubles, have seemingly been unaffected by sulphur and its derivities and during five years of service have required a minimum of repair. Condenser coils are of both continuous and header type, employing iron pipe in their constructing.

Water Wash

Probably the most important factor contributing to the long life of both the metal tower equipment and the iron pipe condenser coils is the continued use of the system of water washing the rising vapors derived from the distillation procedure in the second or No. 2 towers hooked up in series on each still. The gasoline vapors leaving the first towers are then conducted through the second towers, and in rising through this device they are intimately scrubbed and washed by a downward flowing stream of water. This water is collected at the bottom of the tower and removed from the base by means of valves which are opened to regulate the volume of water leaving the tower. The effectiveness of the water wash is further indicated by the appearance of this medium as it leaves the tower, by its blackened color. The affinity of hydrogen sulphide and water is well known, and many who encounter this substance in their processes are subjecting their distillates to a preliminary water wash prior to the usual chemical treatment for removing a certain proportion of the hydrogen sulphide present by such washing. This practice usually makes for greater ease of treating.

In the present case the water wash is given the gasoline merely a few steps closer to the point of origin. While the gasoline is in the vapor state and while the hydrogen sulphide is also in its gaseous form; the water spray in the towers is probably more effective in removing the harmful and corrosive gas than when it has been

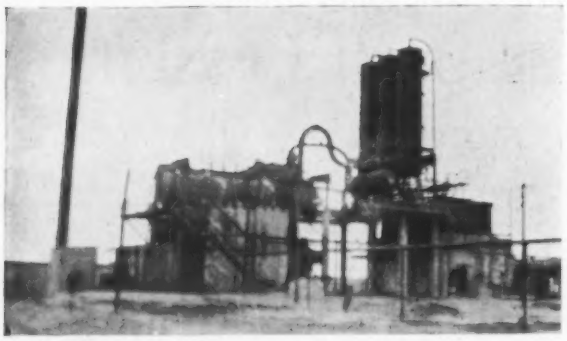


FIGURE 1—JENKINS CRACKING UNIT INSTALLED AT THE TERMINAL OIL AND REFINING COMPANY'S TEXAS CITY PLANT.

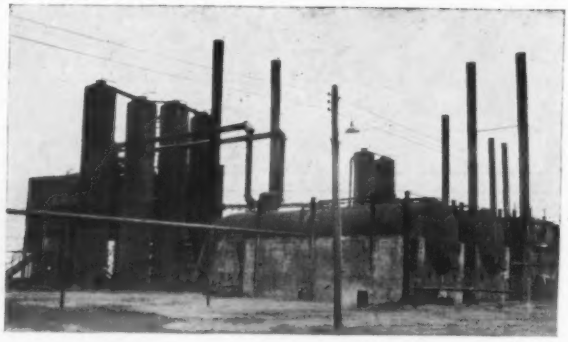


FIGURE 2—DISTILLATION AND FRACTIONATION EQUIPMENT.

condensed. The sulphide gas is harmless when dry, but has an acidic reaction when in the presence of water vapor, or is wet. Thus the steam used in distillation renders it acidic in reaction and results in the corrosion of towers and condenser coils. When this substance is washed out of the gasoline vapors while it too is in the vapor state, the amount passing out of the tower and into the coils is probably not sufficient to cause great damage, except over very long periods.

While the water spray system as employed at the Terminal plant has been in very satisfactory and successful service for several years and during the time the plant has operated upon such crudes as Panuco, Smackover, Spindletop and North Texas, its effectiveness in the case of operation with Panhandle crudes has not yet been definitely ascertained. At the time of the writer's visit the plant had been charging Panhandle crude but about one month, but a shut down for the purpose of inspecting the entire assembly of plant equipment, to look into the matter of corrosion especially, disclosed nothing of importance along these lines. This indicates that the water spray system will continue to to eliminate the major corrosion troubles—such as condenser coil destruction and dephlegmator damage.

No Salt Trouble

The salt usually found with Panhandle production has not yet been the source of trouble. After three weeks of operation the total deposit of foreign matter on the three still bottoms was not one small wheelbarrow full. Further operation over longer periods of time will be necessary before anything of interest regarding the salt present in this oil and the combating of its collection can be recorded.

Treating

Figure No. 3 illustrates the equipment in use for treating the gasoline and pressure products derived from the plant's operation. The products of the pressure plant, Jenkins, are two. The light gasoline taken from the unit direct is treated separately, as is the heavy pressure distillate. This heavy cut is acid treated, neutralized with caustic and subjected to redistillaiton. After this distillation, the gasoline derived from the pressure distillate is treated separately, using sodium plumbite or doctor treating procedure. Straight run gasoline from the skimming plant operation is also treated separately, using doctor solution on this disillate also.

Gasoline from the Panhandle crude has not been difficult to treat at the Terminal plant. The procedure is as follows: Doctor solution of predetermined gravity, stored in quantity in a concrete underground vat, is pumped through small lines to the bottom of the mixer. This mixer or incorporator, is shown extending vertically at the side of the agitator. In figure No. 3 the mixer is constructed in one-foot sections, with a orifice plate inserted at each flange. There are 20 orifice plates in the mixing device. As the doctor solution enters the bottom of the mixer it comes in contact with the stream of gasoline and oil and chemicals are forced upwards through the mixing device to enter the agitator. While the agitator is being charged the doctor solution is continuously circulated in quantity sufficient to treat the gasoline to doctor sweet. Lines and manifolds are so arranged that the caustic or chemical pump may take suction off the bottom of the agitator cone, or from the doctor solution storage tank. When the agitator is charged the gasoline is very nearly sweet, and requires but 10 to 15 minutes agitation to bring it on test. The plant operators state that this treatment secures doctor, corrosion and sun test. The ease of treating it is believed is traceable to the removal of many impurities in the towers where the water spray or wash is employed. After blowing in the agitator to the point where the doctor test indicates that the gasoline is sweet the chemicals are immediately drawn off. Experience has shown that when the chemicals are allowed to remain in the agitator for any length of time to settle, that some of the impurities are again dissolved in the oil to the damage of the sun test and perhaps corrosion. The time required for treating a batch of 450 barrels of gasoline under this system, including the complete cycle of charging in contact with the doctor solution, blowing, drawing off chemicals and dropping the charge is said to be but five to six hours. Three Worthington pumps, size 10 by 6 by 10, are used to charge the different grades of distillates requiring treatment to the agitator and for transferring the finished product to storage.

FIGURE 3—TREATING ASSEMBLY SHOWING AGITATORS AND PUMPING EQUIPMENT. NOTE THE VERTICAL MIXERS OR INCORPORATORS THROUGH WHICH DISTILLATES AND CHEMICALS ARE CHARGED INTERMIXED INTO THE AGITATORS.

Interpretation of Crude Oil Analyses

DURING the past six years, the United States Bureau of Mines, Department of Commerce, has made and published several hundred analyses of typical crude oils and has developed a system of interpreting the analyses and of classifying crudes. The samples analyzed represent petroleum from almost all of the important producing fields in the world and of practically every geological age. The system of interpretation of these analyses, devised by the Bureau, is apparently adequate for classifying crude oils into four main groups and has also been found very convenient in studying the geological relationships between crude oils, and the probable refinery yields of valuable products from them.

Crude petroleum is known to be a very complex substance, says N. A. C. Smith, superintendent of the Bureau of Mines petroleum experiment station, Bartlesville, Okla., in a report just published. An analytical statement of its properties must, therefore, consist of two distinct parts—first, the report of the results of the determinations made by the analyst in the laboratory; second, the proper arrangement, classification and interpretation of these results so that the analysis, as a whole, will indicate the meaning and the relative importance of the essential characteristics of the oil.

This type of analytical statement is useful in judging many raw materials and manufacturer products. To say, for example, that a lubricating oil has a Saybolt Universal viscosity of 300 seconds at 100 degrees F. means little in itself. It is only when other characteristics of the oil are studied in conjunction with the viscosity that a true picture of the oil in question can be obtained. To the experienced refiner of lubricating oils a statement giving simply the viscosity, gravity, and color, and the flash and pour points of the oil will often be sufficient, as he can supply from previous experience his own interpretation of the lata furnished by the analyst. To the layman, however, the analyst's figures would be unintelligible.

Organic materials, such as crude petroleum, on account of their great complexity, require especially careful interpretation if the laboratory results are not to be actually misleading. For example, the percentage of "gasoline" in various crude oils is stated in many of the standard text books on petroleum. Unless one knows, however, just what each particular author means by the term "gasoline" it is impossible to predict the yield of motor fuel from these published analyses.

The method of analysis adopted by the Bureau of Mines for its surveys of typical crude petroleums is a modification of the Hempel distillation method. In brief, the method involves the distillation of a sample of crude oil under carefully controlled conditions that can be duplicated readily, and the subsequent examination of the series of successive fractions thus obtained. In addition, the gravity, color, viscosity, pour point and the sulphur content of the crude itself are determined.

In describing a crude oil reference is often made to its supposed "base." After obtaining the views of many oil producers and refiners, it would seem that the word "base" is used much as it is in pharmaceutical work. For example, the "base" or "basis" of an ointment or salve is the fatty material (lard, petrolatum, lanolin, etc.), used as a vehicle or carrier for the active medicinal principles. Apparently many of the pioneers in the petroleum industry conceived of crude oil as being similar in nature to these medicinal products, in that it consisted of a semi-solid nonvolatile "base" and a volatile portion which could be distilled off to make gasoline, kerosene, etc. Many crude oils when chilled slowly will deposit a waxy material ("paraffin") and this fact may have been one of the reasons why these oils were spoken of as having a "paraffin base." Historically, it happened that the oils first discovered in this country were almost all of this kind, and it was only when the oil industry developed in California and along the Gulf Coast that oils were found which contained no wax but which apparently did contain asphaltic material. These oils were accordingly known as "asphalt base" oils. The use of this term, however, seems unfortunate as the better grade crudes of this type contain little if any asphalt. This fact has apparently been recognized in the petroleum industry and the more descriptive term "naphthene" is frequently used in place of the term "asphalt base."

Oils that cannot be assigned to either the "paraffin" or "naphthene" groups are usually classed as "intermediate-base" crudes. These "intermediate-base" oils in general resemble "paraffin-base" crudes much more than they do "naphthene-base" crudes. It would seem, however, that a fourth type of crude exists, that resembles a true naphthene-base crude except that it contains a small amount of waxy material. To distinguish this type of oil from an intermediate base oil, it has been given the name "hybrid-base" crude.

It is often assumed that the "gravity" of a crude oil is a fair measure of its character. This is true to a limited extent, for example, in many of the producing districts of this country "gravity" is sufficiently descriptive to be used as a basis for crude oil prices. However, the gravity of a naphthene-base crude is much heavier than that of an intermediate or paraffin base crude of the same general quality, hence gravity taken alone is not sufficient to establish the identity of a crude oil.

The physical appearance of a crude is indicated, in the analysis, not only by the gravity, but by the color, the pour point, and the viscosity. The color of a crude oil may range from a very light yellow up to a brilliant brownish black. For oils that are transparent when viewed in a four-ounce bottle by transmitted light the Bureau of Mines uses the "National Petroleum Association" color scale. Most oils, however, are opaque when viewed in this way, and the color by reflected light is reported according to the following system. If the oil is clear in color it is reported as "green," "dark green," or "greenish black;" if it has a brownish or muddy appearance it is reported as "brownish green," or "brownish black."

The pour point of a crude indicates to some extent how it will behave in transportation and storage. Oils with pour points above 50 degrees F. are likely to cause difficulty by solidifying during the winter in storage tanks and pipe lines. The viscosity of oil also indicates its general character, as oils which are deficient in light fractions or which contain large amounts of asphalt in solution have high viscosities.

The sulphur content of a crude oil is very important in discussing its chemical relationships and its refining value, but the base of the crude must also be considered in this connection.

After the distillation of a crude is completed a certain amount of "residuum" is left in the distillation flask. The "carbon residue" or "fixed carbon" in this residuum is of interest as it indicates roughly the presence or absence of asphalt.

In making an analysis of a sample of crude oil "as received at the laboratory" the percentages of free water and emulsified water should be recorded. The percentage of water present is of interest to oil producers and purchasers, but the presence of water in itself has no bearing on the character of a crude oil.

Very little has been said in the foregoing discussion about the actual per-

centages of different fractions present in the oil. In classifying a crude oil the actual percentage of the gasoline fractions, for example, are of relatively little importance. It is the chemical nature of these fractions rather than their percentages that determine the basic character of the crude. However, in studying the value of the crude for refining, the percentage composition becomes very important and a second system of interpretation of crude oil analyses in terms of commercial products is therefore necessary.

The modified Hempel distillation method employed by the Bureau of Mines for the analysis of crude petroleum was not developed with the idea of obtaining figures that parallel the results of actual refinery operations. Refinery practice has not been and probably can not be standardized. The chief value of the method lies in the fact that it not only permits an adequate comparison of different crude oils but it also furnishes the basis for a "rough and ready" interpretation in terms of commercial products.

Detailed information in regard to this subject is contained in Serial 2806, "The Interpretation of Crude Oil Analyses," copies of which may be obtained from the United States Bureau of Mines, Department of Commerce, Washington, D. C.

Plant Shut Down

Los Angeles.—Since the General Petroleum Corporation has shut in its oil production in the Tonner field, it became necessary to shut down the Tonner absorption natural gasoline plant which was producing about 10,000 gallons of gasoline daily. Practically the entire operating crew of the Tonner plant has been transferred to the company's new Alamitos Heights gasoline plant.

High Gravity Plant

Los Angeles.—The Bartlett Gasoline Company, manufacturers of a high gravity gasoline for special industrial uses, is building a new plant in South San Francisco. This is the second plant to be built by the Bartlett Company within the past year, the first having been constructed nine months ago on property adjacent to the Standard Oil Company's El Segundo refinery.

Portable Plant

Los Angeles.—Petroleum Securities Company has erected a Braun portable absorption plant on its Bryant lease in the new Alamitos Heights field. The plant is handling flush production, producing around 4000 gallons of gasoline from about 2,000,000 cubic feet of gas daily. This flush production will be handled later by a permanent plant now under construction.

Survey Shows Concentration of Refinery Capacity at Consumption Points

Refining capacity of the United States at the first of the year 1927, is estimated as a total of 3,061,007 barrels. According to recent reports from the Bureau of Mines, Department of Commerce, by G. R. Hopkins Petroleum Economist, from which survey these figures are taken. On January 1, 1927 there were 465 completed refineries, with seven installations under construction. The capacity as given above is that of completed plants. Of the total of 465 plants completed 327 were in operation, the capacity of which number is given as 2,834,282 barrels. The remaining 138 plants are shut-down, and this non-operating capacity is given as 226,725 barrels. It is estimated that the capacity of the seven plants in various stages of construction will have a combined capacity of 61,000 barrels.

Quoting from the report it is found that "comparison with the figures of a year ago reveals that during the year 1926 there was a net decrease of 45 in the total number of completed refineries but an increase in total capacity of 208,040 barrels. This resulted from a steady growth on the part of many of the larger refineries, particularly those on tide water, which overbalanced the decrease in capacity due to abandonment of a number of relatively small skimming plants. Practically all of the decrase in total number of completed refineries occurred in the Mid-Continent field; that is, Kansas, Oklahoma, and Arkansas including the northern parts of Louisiana and Texas. The mortality rate was particularly high in Oklahoma, where approximately 15 refineries were dismantled in 1926. The only section of the Mid-Continent field where construction was in evidence was the Panhandle district (Texas) where the absence of pipe lines served as the inducement for the building of several skimming plants."

Among the newly constructed refining plants during the year, which are carried in the new survey are those of the Gulf Refining Company at Bayonne, N. J., and the Mexican Petroleum Company at Baltimore, Maryland. Also Gulf's Philadelphia plant and Roxana Petroleum Corporation's new installation at East Chicago, Indiana, are included in the latest report. The state of Washington enters the list of refining states with two plants in operation having a combined capacity of about 5000 barrels. Quoting again from the report, "This expansian of refinery capacity near large consuming centers and the wholesale dismantling of plants near inland producing areas has become a definite trend, the chief cause of which is the lower cost of transporting crude oil than refined products." During the past few years, dating probably from 1922 or 1923, there has been a decided concentration of refining capacity of the principal sea ports on both coasts and in the Gulf Coast area, with a like concentration definitely felt at such points as Chicago in the Great Lakes area. These manufacturing centers are fed by pipe lines transporting the required raw material to the refinery from the inland producing territory. The trend indicates that it is preferable to prepare the finished product at the points of the denser population and at the sea ports where export terminals are located. Transportation charges on crude oil are much lower than freight rates on finished gasoline and other products.

On January 1, 1925, there was 541 completed plants in the United States, as against the present total of 465 refineries, this showing a decrease of 76 plants in the two past years. January 1, 1926 the total number of plants was given as 509, as against the 465 listed in the latest survey—or a decrease of 44 plants during the year.

	Total Capacity Barrels
Figures for 1925 are as follows:	
541 completed refineries	2,827,000
6 building plants	37,000
547 Total plants	2,864,000
For 1926 the survey indicated as follows:	
509 completed refineries	2,850,000
2 building refineries	5,000
511 total plants	2,855,000
January 1, 1926—	
157 refineries were shut down	290,000
352 refineries were operating	2,560,000
509 total completed plants	2,850,000
The latest survey, January 1, 1927 is as follows:	
327 refineries were operating	2,834,282
138 plants were shut down	226,725
465 total completed plants	3,061,007
7 plants reported as building	61,000
472 total plants this year	3,122,007

Length 41 feet. Inside diameter 7 feet. Wall thickness, 3¾ inches. Weight 147,900 pounds.

Accurate to 1/8th of an inch in 41 feet of Length

Smithsteel Cracking Stills are built to extraordinary limits of accuracy.

Prior to the time that the vessel shown above was made in Smithsteel the builders were allowed a tolerance of 3 inches in 41 feet—1½ inches on each side of the horizontal axis. The Smithsteel Cracking Still shown above varies less than ⅛th of an inch in the entire 41 feet of length.

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Smithsteel Cracking Stills can be built to any diameter and length within transportation limits—and in any wall thickness within steel mill capacity.

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Smithsteel Cracking Stills have a continuous record of successful operation in the field under the most exacting and varied conditions.

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Cost

Smithsteel Cracking Stills do cost more than vessels made by some other methods. The extra cost is the price of safety.

A. O. SMITH CORPORATION *Milwaukee, Wisconsin*
Oil Field Products Division Los Angeles

Pressure Regulation as Applied to The Gasoline Industry

*By J. V. THOMAS**
Natural Gas Equipment Company

PRESSURE regulation has made remarkable strides toward accuracy during recent years. This subject, as an important factor in gasoline plant operation, has found its way into every department of the process and at the present time throughout the entire natural gasoline industry, accurate pressure control is recognized as being positively essential for efficient operation. During this development period, (in which the absorption method of gasoline extraction evolved from an experiment into the present generally accepted process), many new needs for regulators were disclosed.

The old style regulators were not sufficiently sensitive to qualify and in order to satisfactorily meet the requirements, regulator manufacturers have found it necessary to incorporate new features in the design of their products.

The present high state of efficiency of this equipment is largely due to suggestions and constructive criticism offered by the personnel of the natural gas and petroleum industries.

Those who have not closely followed the progress made in this field may find it rather difficult to analyze the methods of operation employed, and no doubt would be quite at a loss if for any reason it were necessary that they thoroughly understand the workings of a pilot operated regulator. The design and operation of the latest types of regulators as well as their numerous uses will be covered briefly in this paper.

Design and Operation

The single diaphragm type of regulator is marketed in two general classes: First, the type in which the actuating pressure is opposed by a weighted lever, and second, the type in which the actuating pressure is opposed by spring tension. Adjustments for various pressures are made either by adding or removing weights from the lever or by increasing or decreasing the spring tension by means of an adjusting nut.

When the desired working pressure cannot be obtained in this manner it then becomes necessary either to change the diaphragm or springs, as the particular case requires.

It might be well here to briefly consider the relative merits of the two different classes, for each has its particular utility. The weighted regulator can be furnished at a lower cost. This feature alone recommends its use for certain services. For example, it is common practice in the oil fields to use the weighted lever type of regulator on wells to maintain a constant casinghead pressure. Wherever a spring loaded type is installed for this service, it is usually because more accurate regulation is necessary in that particular instance. These casinghead regulators are usually for very low pressures which permits the use of large diaphragm and therefore, with the weighted type, close enough regulation can be maintained.

On the other hand you have all seen the weighted type of regulator become obsolete as a boiler fuel regulator. There are several reasons why the spring loaded type has succeeded the weighted type for this service. First, the heavier and faster drilling equipment now used requires immediate response from the boiler plant, therefore finer regulation is necessary. Second, the increasing use of natural gas as an industrial fuel has made possible the sale of surplus gas, and greater regulator efficiency was demanded to prevent boilers from popping; to keep steam at the required working pressure at all times, and mainly to supply fuel in as even a flow as possible. This latter is of vital importance and yet is seldom considered. Rapid changing of firebox conditions is very inefficient and detrimental even though the steam pressure may be held constant. Third, the long arm on the old style of boiler regulators was a continual annoyance and too often did the firemen lend the weight of a foot to the lever arm to temporarily pick up steam. At such times the firebox was smothered with gas and efficiency was sacrificed.

Two instances have now been cited in which two different types of regulators were commonly used. The fundamental reasons for operators discriminating between regulators in these two cases are cost, and efficiency or accuracy. For one service, accuracy does not seem to be essential and cost is the deciding factor. For the other service, accuracy and efficiency are desired, therefore additional expense is warranted.

Requirements

To be efficient a regulator must be so designed as to be practically friction'ess. It must be in perfect alignment and all chance for stem binding eliminated. The valve mechanism must be as nearly balanced as is possible. For instance, there must be an even number of ports, usually two, having the same area. These ports must be so located that the difference in pressure of the fluid passing through them is exerted in opposite directions, thus balancing the effect of the pressure in the valve. For comparison, we will analyze the effect of pressures on a single ported valve. Consider a three-inch back pressure single ported regulator relieving fluid from 30 pounds pressure to atmosphere. The area of this three-inch valve is 7.07 square inches. 7.07 x 30 gives a total pressure exerted in one direction of 212 pounds. This must be opposed by an equal force in the opposite direction. This force may be either spring tension or a weight arrangement. Now, if there were a back pressure applied to the outlet side of this valve and it was desired to relieve this 30-pound line, the regulator would no longer operate at 30 pounds back pressure because the actual pressure exerted in one direction upon the valve would only be the difference between 20 pounds per square inch and 30 pounds per square inch or a total weight of 70.7 pounds instead of 212 pounds. The result would be that the inlet pressure which should be relieved at 30 pounds would build up to 50 pounds before the valve would open. At 50 pounds inlet pressure and 20 pounds outlet pressure, obviously there is a resultant force of 30 pounds per square inch to operate the valve. The valve is doing exactly what it did before, but the pressures are different, and the desired results are not obtained. The inlet pressure increased when the outlet pressure increased because of the design of the valve. It was originally built to function on the difference in pressure; that is, the difference between 30 pounds and atmosphere, and may be relied upon only when these conditions prevail.

With the two ported or four ported valve the effects of the line pressure are balanced and the forces actuating the valve are applied externally to the valve stem. It is therefore of great importance that the valve mechanism be balanced.

Pilot Operated Regulation

There are still other uses for regulators which demand even closer regulation than can be obtaineed with the most accurate single diaphragm type. The pilot operated regulator has been

*Presented before general meeting of the California Natural Gasoline Association, April 21, 1927.

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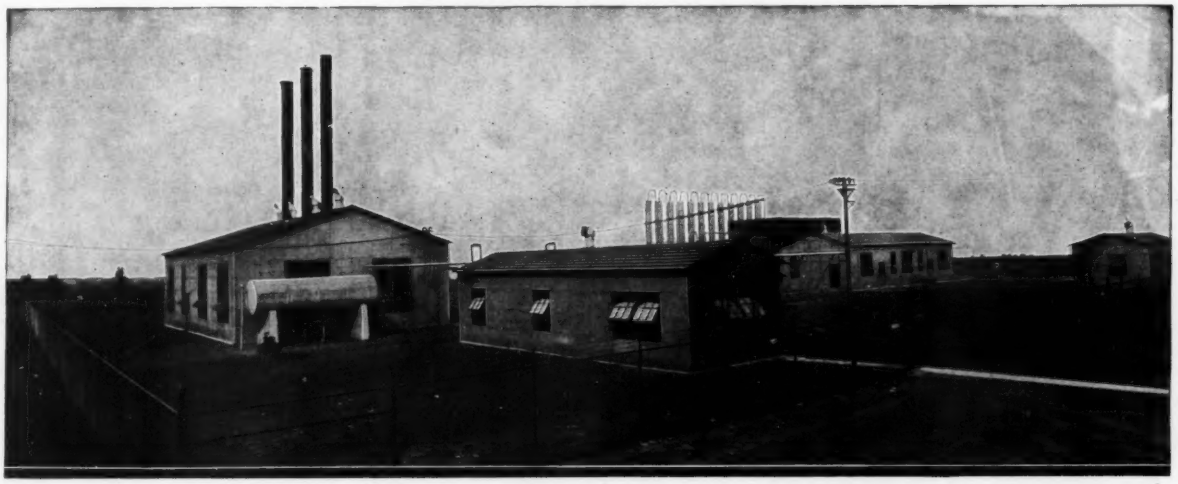

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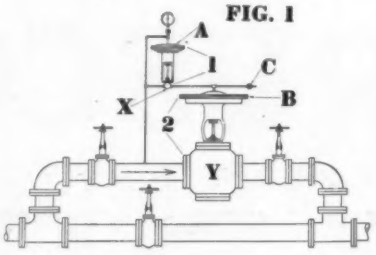
There are several different applications of the pilot arrangement but the basic principle is the same in all cases. Any pilot operated valve consists of two regulators. The main regulator which is installed in the main line and an auxiliary pilot regulator; the diaphragm of the pilot regulator being connected to the main line. The pressure on the diaphragm of the main valve is actuated entirely by the pilot mechanism. There are two ways in which this pilot principle may be applied.

To clearly set forth these two methods, we will refer to the accompanying sketches. Figure 1 represents the

FIG. 1

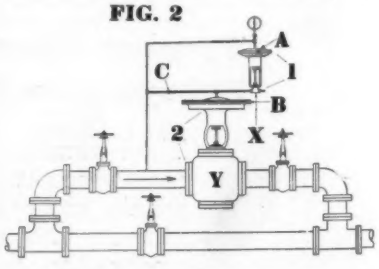


method wherein the pilot regulator "1" admits the pressure to the main diaphragm "B" of regulator "2," and when closed the pressure is relieved through a fixed opening "C". This fixed opening may be either a small orifice or a needle valve slightly cracked.

Assuming this arrangement is to maintain a constant back pressure of 60 pounds, the operation would be as follows: When pressure tends to fall below 60 pounds, total force exerted on diaphragm "A" decreases, thus effecting a slight movement of the pilot valve "X" in the direction of "A" caused by a mechanical force either weighted lever or spring tension, whichever the case may be. In these illustrations, we will assume that the pressure exerted upon the diaphragm is opposed by spring tension. This movement of valve "X" in the direction of "A" we will say closes valve "X," thus preventing any flow of fluid to diaphragm "B." Whatever pressure was contained in diaphragm "B," due to "X" being partly open, will then be relieved through fixed opening "C." This decrease in pressure on diaphragm "B" permits the spring tension to move valve "Y" in the direction of "B" until closed. When valve "Y" commences to close, thus diminishing the flow of fluid being relieved, the desired 60 pounds will immediately be restored.

Conversely, if the 60-pound pressure tends to increase this added weight on diaphragm "A" compresses spring and moves slightly in direction of "X," thus slightly opening "X" and admitting some of the 60-pound fluid into diaphragm "B." The pressure on diaphragm "B" increases or decreases as the relation of the area of "X" to constant opening "C" increases or decreases. As the pressure on diaphragm "B" increases it compresses its opposing spring force and moves in the direction of "Y," thus opening "Y" and maintaining the desired pressure.

FIG. 2



In Figure 2, the pilot valve "X" governs the bleed from diaphragm "B," and the fixed opening "C" is on the inlet to diaphragm "B" instead of outlet. In other words, there positions are reversed and the operation is as follows: Assuming the same conditions as in Figure 1, and assuming that valve "Y" moves downward to close—because obviously if the pilot valve is regulating the outlet instead of the inlet, then the action of either the pilot valve or the main valve must be reversed to compensate—we will assume the action of the main valve is reversed and closes when valve moves down instead of up as in Figure 1.

When 60 pounds pressure tends to

(Continued on page 90)

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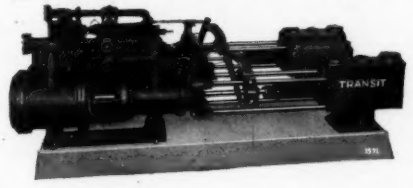
openings packed with sheet aluminum gaskets, insure against leaks; and furthermore in order to prevent any possible leakage at the piston rods, we make a very deep, water jacketed stuffing box, so deep, that the hot part of the rod never runs up into the packing, much less into the open air. Two sets of packing and a lantern gland insure against leakage. This is common to all pumps illustrated on this page.

TRANSIT

twin single hot oil pump with forged steel fluid cylinders and water-cooled Hot Oil Type stuffing boxes. "Twin single" means that two single steam pumps are connected together. Their operation is controlled by a synchronizing device, a part of the valve motion of the pumps.

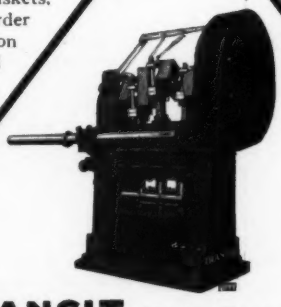
Either of the two single pumps is made large enough to handle the capacity required at nor-



mal speed. When running together, or synchronized, they operate at approximately one-half normal speed. Thus we obtain an easy running, slow speed, long stroke and consequently long-lived machine.

Through this synchronizer control either pump can be shut down at will. Immediately and automatically on shutting down either pump the other pump doubles up both in speed and capacity.

Hot oil up to 1000° F. can be handled at working pressures up to 1000 lbs.



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Action of Sulfur Monochloride on Petroleum Hydrocarbons

(Continued from page 62)

the undistilled portion turned brown and the temperature rose suddenly. The distillate was colorless and contained no sulfur, but gave a distinct chlorine reaction. Sublimed sulfur could be seen in the flask.

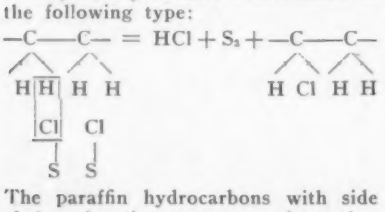
Light Kerosene Fraction (distilling between 200 degrees and 225 degrees C.)—The sulfur chloride treatment was carried out between 100 degrees and 150 degrees C. Apparently no change occurred. However, the distillation of the product freed from sulfur chloride gave fractions that were somewhat different from those of the original sample. About 13 per cent went over below 200 degrees C. and about 12 per cent above 225 degrees C. The distillation was colorless until the temperature reached 230 degrees C. From this point the temperature rise was rapid and the distillate became yellow. The fraction below 230 degrees C. was found to contain chlorine but no sulfur. The yellow distillate contained both, but the sulfur may have been carried over mechanically with the distillate.

Higher Boiling Fractions—The higher boiling fractions gave similar results.

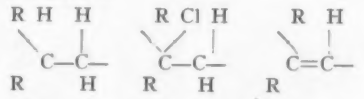
Diisoamyl was found to occupy a position between the saturated and the unsaturated hydrocarbons. At ordinary temperatures there was no sign of reaction, but a continued heating at 100 degrees C. and higher with an equal volume of sulfur chloride resulted in a marked reaction. Hydrogen chloride escaped slowly, and after 6 hours of heating the color of the mixture became dark brown. After cooling, monoclinic sulfur crystallized. The same amount of sulfur chloride as before was added and the mixture heated for 6 hours more. Hydrogen chloride developed and the liquid turned black. A tarry substance separated similar to that in the case of amylene. The sulfur crystallized in rhombic form.

Nature of Reaction

This incomplete analysis of the action of sulfur monochloride shows an outstanding difference between the behavior of saturated and unsaturated hydrocarbons. The sulfur monochloride is a general reagent for the unsaturated chain. It reacts even with such low-boiling members as amylene. The slow and moderate action on saturated straight chains is essentially different. It is probably a mere chlorination of the following type:

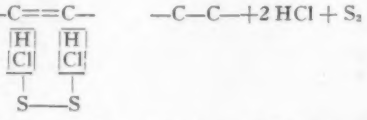


The paraffin hydrocarbons with side chains give the same type of reaction when moderately heated, but the reaction rate is higher. By continued heating to a higher temperature, probably two neighboring carbon atoms lose a molecule of HCl and form a double bond:



Furthermore, the resulting compound, like other unsaturated hydrocarbons, undergoes polymerization and condensation.

The nature of these latter reactions could not be established, but Meigs' ideas about sulfur compounds and their condensation and polymerization do not seem very probable. The fact that a considerable amount of sulfur crystallizes from the reaction product shows that here also the action of sulfur monochloride probably consists in chlorination and the subsequent formation of a double or triple bond. The condensation probably occurs between two molecules, with elimination of hydrogen chloride. Meigs himself points out the possibility of triple-bond formation, and this reaction seems very probable:



This reaction might immediately produce the triple bond, or at lower temperature chlorination might occur, with subsequent removal of hydrogen chloride:

Guthrie[2] describes an addition compound of sulfur monochloride and "amylene" analogous to mustard gas. It would be conceivable that whenever sulfur monochloride acts on unsaturated hydrocarbons a similar product is primarily formed which decomposes by heating. However, the unsaturated hydrocarbons, with the increase of the carbon atoms, react more and more violently, and thus the formation of such a primary addition product is improbable.

Tests for Degree of Unsaturation

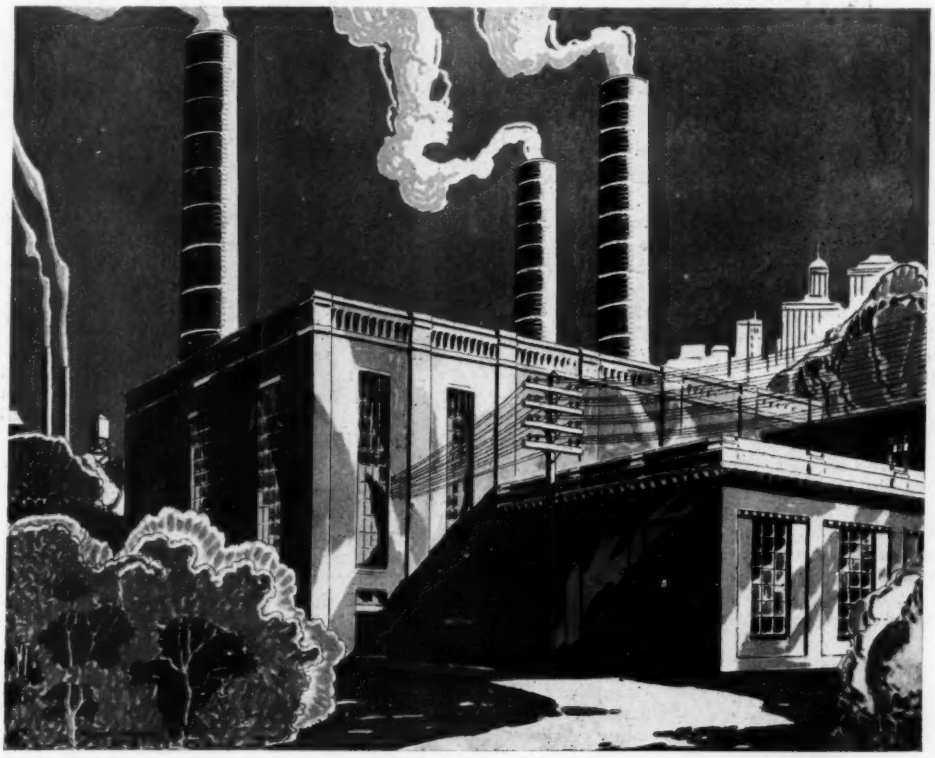
Meigs developed a method for determining the hydrogen chloride as one product of the reaction and proposed to use it as a comparative test for bituminous substances. Since the reaction has been shown to be more general, it could serve as a basis of a test for unsaturated hydrocarbons. This test might be worked out along two different lines, one being a modification of Meigs' method.

Method I—Meigs stated that the action of sulfur monochloride is a "time reaction," since the evolution of hydrogen chloride continued for many hours without stopping. The above observations show that in a mixture of saturated and unsaturated hydrocarbons the latter react vigorously and cause the major part of the reaction. The saturated compounds or, better, the saturated chains react slowly and are responsible for the "time reaction." Therefore the test should be carried out in such a way that after the main reaction and a subsequent heating for a definite short period the absorption of the hydrogen chloride is stopped. A solvent is necessary for higher fractions or crude oils, since they react too violently if mixed direct with sulfur monochloride. Meigs used carbon disulfide for this purpose, but carbon tetrachloride, or another chlorine derivative with a higher boiling point, seems to be preferable, irrespective of the fact that carbon disulfide reacts with sulfur monochloride. This is unquestionably true for the liquid which has the function of absorbing the sulfur chloride vapors which would hydrolize in water and increase the amount of absorbed hydrogen sulfide. Meigs was obliged to use water as absorbent for the hydrogen chloride since the carbon disulfide vapors would react with the alkali. By the substitution of a chlorine derivative for the carbon disulfide, sodium hydroxide could be used without fear.

This is one method which was tried in a few cases. It turned out to be practicable and gave comparative results. A more thorough study is necessary to decide its value in comparison with other methods.

Method II—A few experiments were carried out in another direction for the purpose of developing a testing method. The petroleum fractions were dissolved in carbon tetrachloride and mixed with about half as much sulfur chloride. The mixture was refluxed on a water bath for two hours. About an equal amount of water was added to the reaction mixture to hydrolize it and this mixture was then slowly neutralized by sodium hydroxide. The whole mass was washed with carbon tetrachloride in a separatory funnel. After removing the alkali layer the content of the funnel was washed with water until neutral. The carbon tetrachloride was driven off and the residue distilled at an absolute pressure of 30 mm. of mercury. The lowering of the boiling point was taken into account in determining the end point of the distillation. This corresponded to the higher limit of the original range of the fraction. Both distillate and residue were weighed. Either the amount of the residue or that of the distillate subtracted from the original quantity of the petroleum sample could be used as a comparative basis for the degree of unsaturation.

This is a second method which seems to be especially useful for testing lower fractions, since there is a considerable difference between the boiling range of the unchanged part of the fraction and that of the polymerized or condensed products.



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Measurement of Bloom of Lubricating Oils

By L. M. HENDERSON and H. C. COWLES, JR.,
The Atlantic Refining Co., Philadelphia, Pa.

IT HAS been customary to describe the color of a mineral oil observed by reflected light with such expressions as "pea green," "olive green," "blue green," and the like. Such terms are subject to loose interpretation by different observers. It is not possible to specify with any great precision the reflected color—i. e., bloom, of an oil by such terminology, or to indicate accurately the smaller variations in different lots of a given oil. The situation has led to a search for a numerical expression. It does not seem feasible to match the bloom of lubricatnig oils with the colors of solutions of organic dyes or mineral pigments.

The Ives tint photometer has been used in many industries for measuring

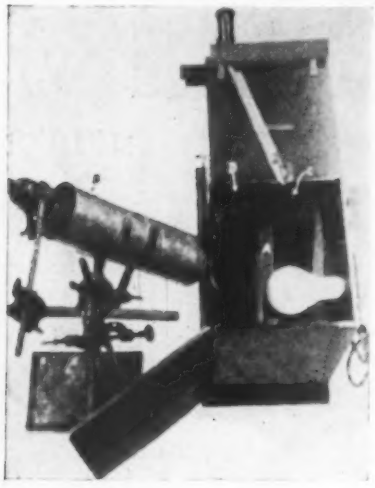


FIGURE 1—MODIFIED IVES TINT PHOTOMETER

the reflected color of opaque bodies and this instrument offered possibilities for the measurement of the bloom of oils. An attempt was made to use it in the same manner as it is used for measuring the colors reflected by opaque objects. A crystallizing dish containing the oil was placed on a black surface and the colors reflected from the oil were determined. The light did not strike the surface at a satisfactory angle. Readings on the photometer scale indicated almost equal absorption of all the spectral colors and showed that not more than 3 per cent of the light striking the oil surface was reflected. From the results thus obtained, it was evident that the light falling on the oil surface must have about thirty-two times the intensity of the light originally supplied in the apparatus. The light rays must strike the oil at such an angle as to reflect the maximum bloom colors through the eye piece of the tint photometer.

Modification of the Ives Tint Photometer

Figure 1 shows the tint photometer as modified for the determination of bloom. A sheet metal septum *A*, was fitted into the light chamber to prevent the light from the photometer lamp striking the oil. An auxiliary lamp, *B*, was installed so that a beam of light might be cast on the surface of the oil at an angle of 45 degrees. This lamp was placed in a metal tube approximately 7.66 cm. in diameter and 22 cm. long, which was adjusted in such a manner that its lowest point was 19 cm. above the table top. When an auxiliary lamp was used of such power that the light reflected from the oil surface was 32 times as great as originally supplied by the photometer lamp, the oil heated too rapidly. It was therefore necessary to interpose a screen with a density of 0.6 in the path of the rays from the photometer lamp. This permitted the use of an auxiliary lamp of about one-fourth the intensity that would otherwise have been required. Wrattan Neutral Filters were used as screens because they can be duplicated with sufficient accuracy and are easily obtained.

The spectrum of the auxiliary light must closely approximate that of the photometer lamp. The ordinary 75-watt Madza bulb proved quite satisfactory. Table I shows the effect of variations in the illumination and elevation of the oil surface. Diffused light shows appreciably less bloom than the open Madza, while a narrow slit of light is of no advantage. The best results were obtained with an elevation of the oil surface at approximately 16.5 cm. and with the lowest point of the light tube 2.5 cm. higher.

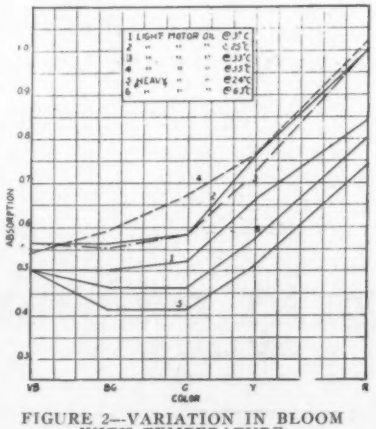


FIGURE 2—VARIATION IN BLOOM WITH TEMPERATURE

The auxiliary lamp was standardized in somewhat the same manner as the regular photometer lamp save for certain details which are enumerated below. The surface of the horizontal magnesia block was raised to a level 17 cm. above the bottom of the tint photometer, and the lower edge of the

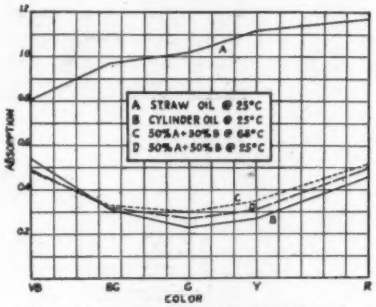


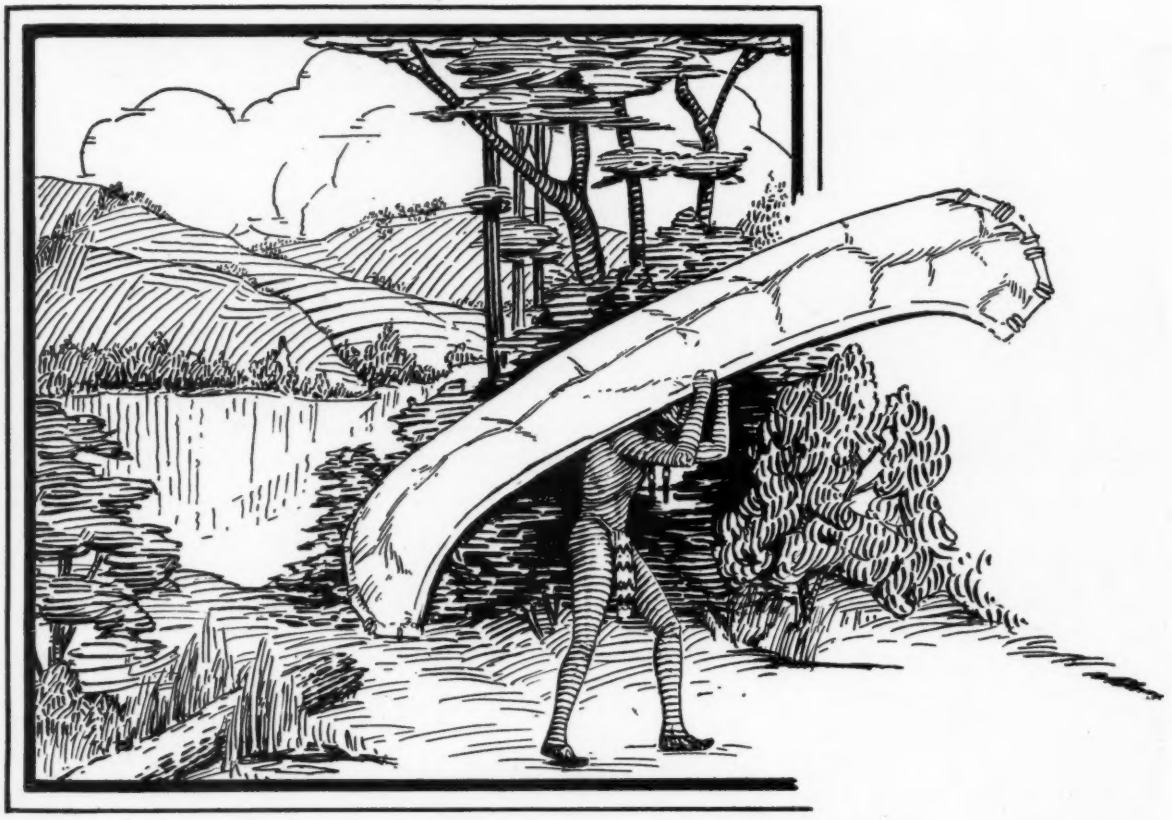
FIGURE 3—EFFECT OF BLENDING

lamp tube placed approximately 3 cm. above the magnesia block. A neutral filter with a density of 1.5 was then inserted at *D* in the path of the rays from the auxiliary light, the filter of 0.6 density remaining in the path of the rays from the photometer lamp, at *D*. The end of the metal tube was moved toward or away from the magnesia block until the field of light in the eye piece balanced that of the standard lamp. The magnesia block was maintained at such elevation as would give maximum reflection. A pointer which had been attached to the side of the photometer was then brought into contact with the top of the magnesia block and its position fixed.

Type of Container

Considerable difficulty was experienced in securing a container for the oil which would reflectlittle or no light. Of those tried, the most satisfactory was a crystallizing dish (40 mm. deep) which had been sand blasted inside and out and then painted on the outside with a dead black lacquer. Even this container reflected a small

*Reprinted from Industrial and Engineering Chemistry January, 1927, and presented before division of Petroleum Chemistry of the American Chemical Society at Philadelphia, 5 to 11, 1926.



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amount of white light. It must be noted that in using a container of the above type, the color measured was that reflected from an oil-air interface. Colors reflected from this surface were found to be somewhat different from those reflected from an oil-glass interface. On account of obvious difficulties in the use of the oil-glass interface and the different color absorptions encountered with various glasses, the oil-air interface was adopted as the standard.

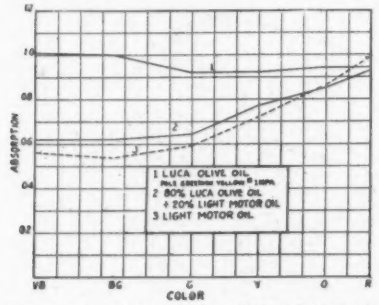


FIGURE 4—OLIVE OIL AND MINERAL OIL

Most lubricating oils are quite transparent to red but rather opaque to the blue rays. Consequently, in the case of pale oils the amount of red which is reflected from the oil-air interface is augmented by the red rays reflected from the inner surface of the container, while the amount of blue reflected remains unaltered. This condition changes the shape of the bloom curve. To reduce this error to a minimum, the depth of the oil layer under observation was made as great as practicable for convenience, 35 mm. Table II shows the variation in bloom with increasing depth of oil.

Determination of the Bloom

To determine the color reflected from the surface of an oil the neutral filter of 1.5 density at D and the magnesia block are removed. The oil, which is contained in a black crystallizing dish, is placed on the adjustable table and raised until the surface of the oil touches the pointer. The series of color filters is then inserted in the slot of the eye-piece and the absorption of each color read on the instrument's scale. The absorption thus noted is expressed as the common logarithm of $\frac{1}{\text{reflection}}$. For example, if 25 per cent of the light is reflected, the absorption is equal to 0.602. The observations were made upon the oils at a temperature of approximately 35 degrees C. and in a dimly lighted room.

Inasmuch as a filter of density 1.5 was in the path of the light from the auxiliary lamp when it was standardized against the photometer lamp and this filter was removed when the bloom of the oil was measured, each absorption value given in this paper is 1.5 less than the true absorption by the oil. The figures given are the instrument scale readings. If absolute absorption is desired it is only necessary to add 1.5 to these values.

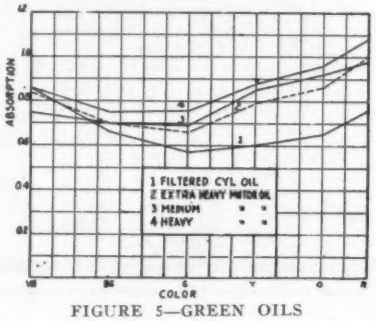


FIGURE 5—GREEN OILS

Influence of Temperature on Bloom

Figure 2 indicates the influence of temperature on the readings, particularly in the case of paraffin distillates. At higher temperatures these oils reflect less of all the colors, with the least change in the blue, but upon cooling to the original temperatures, they assume their original blooms. The colors reflected by cylinder oils vary but little with change in temperature, as shown in Table III. The blooms of these oils have been expressed graphically by plotting the common logarithm of $\frac{1}{\text{reflection}}$ as ordinate against the color of each light filter as abscissa. As a matter of fact, it is the average wave length of the maximum transmission of each of the light filters that has been plotted on the abscissas. This accounts for the unequal spacing of the spectral colors in the graphs.

Effect of Blending

A mixture of equal parts of a decidedly blue distillate and a bright green cylinder oil gave a green blend closely approaching the reflected color of the cylinder oil. In common with cylinder oils, the bloom of this blend was but little affected by rise in temperature. The modification of the bloom of a light motor oil by the addition of olive oil in an amount equal to four times its volume was comparatively slight and quite disproportionate to the amount of mineral oil in the blend. Figures 3 and 4 show the bloom of the two blends in comparison with those of their constituents.

Results of Bloom Determinations

A number of 4-ounce sample bottles of oil were inspected for their bloom and classified as they appeared to the eye. The classifications were green, blue-green, and blue oils. The fourth class included oils which had been sun debloomed and those commonly considered bloomless. The first three

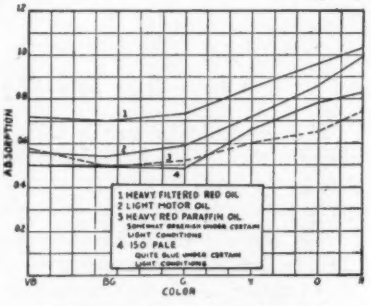


FIGURE 6—BLUE-GREEN OILS

Table I—Effect of Height of Oil Surface, Auxiliary Light, and Direction of Light Rays on Bloom Readings
Red paraffin oil

Angle Between light Tube and Oil Surface Degrees	Height of Oil Surface Cm.	Height of Light Cm.	Absorption VB	BG	G	Y	R
45	15.25	16.5	0.31	0.10	0.035	0.065	0.125
30	16.5	19.0	0.49	0.42	0.41	0.53	0.62
60	16.5	19.0	0.48	0.44	0.41	0.54	0.59
20	21	23.5	0.52	0.47	0.50	0.60	0.68
20	22	24.6	0.57	0.50	0.49	0.62	0.70
Filtered cylinder oil							
45	15.25	16.5	0.31	0.10	0.035	0.065	0.125
45	17.8	19.0	Impossible				
45	17.8	20.3	0.31	0.115	0.040	0.075	0.18
45	20.3	23.0	0.38	...	0.12	...	0.25
45*a*	17.8	20.3	0.55	...	0.29	...	0.40

Average wave length of maximum transmission of each color filter:
VB—Violet-blue 450μμ Y =Yellow 575
BG=Blue-green 495 R =Red 650
G =Green 540 O =Orange 630
*Ground glass D= 0.58 at end of tube.

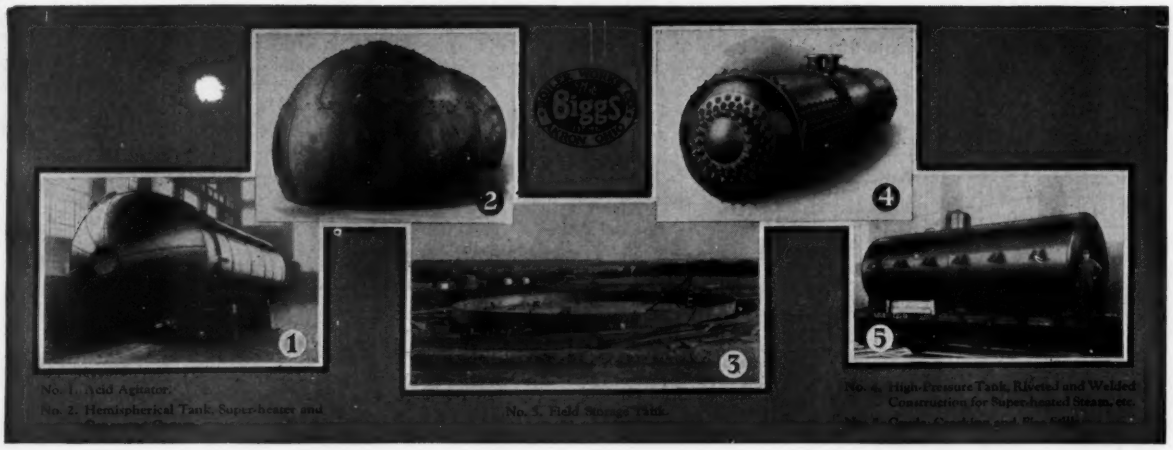
Table II—Variation in Bloom Due to Variation in Depth of Oil.

Oil	Depth of Oil Mm.	Absorption VB	BG	G	Y	O	R
A	0.3	0.81	0.81	0.79	0.81	...	0.80
A	12	1.02	1.02	0.99	1.00	1.01	1.08
A	24	0.98	1.07	1.01	1.00	1.02	1.07
A	36	0.99	1.08	1.01	1.00	1.07	1.13
B	24	0.66	0.79	0.80	0.48	0.85	0.84
B	36	0.76	0.88	0.95	1.04	1.06	1.10
C	24	1.25	1.25	1.08	0.82	0.71	0.71
C	36	1.20	1.17	1.07	0.99	0.96	0.97

A=light distillate, 1.75 N. P. A.; B= filtered oil, 1 N. P. A; C =debloomed oil 3.5 N. P. A.

Tablt III—Variation in Bloom of Cylinder Oil with Temperature

Oil	Temperature of Oil °C	Absorption VB	BG	G	Y	R
Filtered cylinder	25	0.54	0.31	0.23	0.27	0.46
Filtered cylinder	60	0.58	0.35	0.27	0.30	0.50



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groups are shown in Figures 5, 6, and 7. The few cases in which the graphs indicate a somewhat different bloom from that which was apparent to the eye is due to the change from an oil-glass to an oil-air interface. In Figure 8 it is

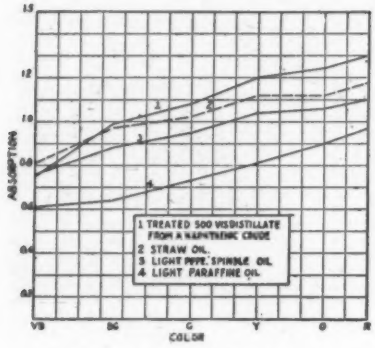

FIGURE 7—BLUE OILS

shown that the deblooming of an oil greatly increases its ability to absorb blue light. These oils, in common with fatty oils, give a reflected color similar to their transmitted color.

The reflected colors of asphalt and medicinal white oil (dark gray with a blue-green tint) are quite similar. It is probable that a container more nearly black than the one available at present would show the white oil to be as dark as the asphalt when viewed by reflected light. In general, the light distillates are darker by reflected light than are the cylinder oils.

As is the case with all colored objects, the reflected color of an oil is indicated by the relative absorption of the different colors of white light. The shape of the curves here presented indicates the bloom of the oil by showing the relative amounts of the five principal colors. The steepness of the curve on each side of the color least absorbed shows the brightness of the color, or in other words, shows how nearly monochromatic the color is. For example, a curve with a deep trough in the green shows a bright green, while the curve for another oil, which is predominantly green, may be more nearly horizontal and if so represents a dull gray-green bloom. Furthermore, two bloom

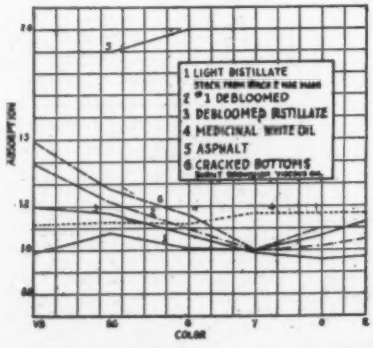

FIGURE 8—DEBLOOMED AND BLOOMLESS OILS

curves may have the same shape but one may lie higher than the other. If such be the case, the two oils reflect the same color, but the one corresponding to the higher curve is darker because if reflects less light. In addition to the values of reflection at various wave lengths, the value of the total reflections may be obtained with the instruments.

Alamitos Plant Starts Operation

Los Angeles.—The "Alamitos" absorption gasoline plant of the General Petroleum Corporation was recently started operating. The plant is of the Campbell "Oil Froth" type, and was completely constructed and placed in operation in 35 days. The equipment consists of two Campbell absorbers of a new size, namely, seven feet in diameter, and have a capacity of seven million cubic feet of gas daily for each tower, and are capable of overload to the extent that the plant may produce 25,000 gallons of gasoline daily with its present equipment. There are several new features incorporated in the construction of this installation, one of them being the adjustable devices controlling the water spray over the cooling coils. The cooling coils are constructed with welded return bends. The water sprays are adjusted by two central control levers so that the water may be directed to overcome the deflection of direction caused by varying wind velocities. Each lever adjusts the sprays on one side of the cooling tower.

The new "Alamitos" plant is operating under the supervision of J. W. Scott, superintendent of operation; J. L. McMahon, superintendent of the Southern division, and H. W. Havins, plant foreman.

Enlarge Plant

San Angelo, Texas.—Daily crude capacity of the San Angelo Refining Company's skimming plant located near this city will be 1500 barrels upon the completion of enlargements early in July. This plant is handling about 700 barrels of West Texas crude daily, receiving same via tank cars, and is marketing the bulk of its products locally. It is one of the few skimming plants in Texas located off pipe line facilities and removed considerable distance from oil fields that is operating regularly.

Cross Cracking Units Put In Operation by T. P.

Fort Worth.—The new Cross cracking unit, with capacity rated at 1000 barrels at the Fort Worth refinery of the Texas Pacific Coal & Oil Company, was started in operation during the first part of June. This unit is the second of its kind in the United States, the first installation being in operation at Providence, R. I., at the refinery of the Standard Oil Company of New York. With this type of unit raw crude oil can be charged to the still and along with the removal of gasoline, both gas oil and fuel oil can be taken off at the one operation. The cracking unit may be charged with either crude, gas oil or fuel oil. Specially designed hot oil pumps are installed.

Through the installation of a Gray polymerizing tower, installed for vapor phase treating of the gasoline in the unit, this product may be taken off as finished gasoline, requiring no redistillation. Chief among the list of auxiliary equipment is a vapor recovery plant which has been installed to extract the valuable components of the so-called uncondensable vapors. It is planned to extract about 1000 gallons of gasoline daily through the vapor recovery plant, and to employ the dry gas leaving this plant for fuel purposes under the Cross unit.

Refinery Will Operate on Panhandle Oil

Amarillo, Texas. — Dorsett Carter and associates of Amarillo are organizing a new company to be known as the Texarillo Refining Company, to construct a 5000 barrel daily capacity skimming plant near Amarillo at an estimated cost of $200,000. This plant will operate exclusively on Panhandle crude, which will be delivered from the field via the Pantex Pipe Line Company's six-inch line. This plant will be equipped with the Rowsey process, which has been particularly successful in handling the sulphur and water content of the Panhandle crude.

More Dubbs Units Being Installed

Chicago—Universal Oil Products Company announces that the British American Oil Refineries, Limited, Toronto, Ontario, Canada, will install one 1000-barrel Dubbs cracking unit immediately.

Two Unit Plant

Los Angeles.—Geo. F. Getty, Inc., has recently completed the installation of a two unit gasoline absorption plant at Alamitos Heights, Long Beach, which will handle the gas production from the company's own wells, and a number of other wells in the immediate vicinity. A new company has been formed, Geo. F. Getty Gasoline Company, for the purpose of handling the gasoline production separately from the production of crude oil, and this company will direct the operations of the plant at Alamitos Heights and the gasoline plant at Santa Fe Springs, which the producing company has been operating for a number of years. The new plant is located at Eighth and Ultimo Street, and has a rated capacity of around 5000 gallons of gasoline per day.

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Pressure Regulation As Applied to the Gasoline Industry

(*Continued from page* 80)

increase, slightly greater force is exerted on diaphragm "A"; this overcomes the resistance of the spring tension and diaphragm "A" moves slightly in direction of "X," thus opening "X" and relieving the pressure from diaphragm "B." As pressure is released from diaphragm "B," spring tension opens valve "Y" sufficiently to maintain the desired 60 pounds. Conversely, if the 60 pounds pressure tends to decrease, valve "X" starts movement toward "A" and checks the flow from diaphragm "B." Pressure then builds up on diaphragm "B" through fixed opening "C." This increase in the main diaphragm pressure overcomes the resistance offered by spring tension and starts closing valve "Y," checking volume of fluid passing in order to maintain the desired 60 pounds.

One manufacturer may so closely incorporate the two units that one is an integral part of the other, or he may deviate considerably in the travel of the fluid to and from the pilot valve. Another may incorporate the use of weights while others use springs but, in any case, the fundamental principle is identical. The sketches submitted and the outline are merely to illustrate this principle. They represent the basic formula in which a number of the quantities are variable. With the use of this method of regulation, extremely accurate results may be secured. The reason is self-evident but may be briefly stated as follows: Only a fraction of a pound change in pressure will, through the medium of the pilot valve, supply sufficient pressure to the main operating diaphragm to obtain the full stroke of the main valve. For perfect operation, pilot operated regulators must be so designed that the entire unit is in positive equilibrium at all times, otherwise a pumping motion or a lag will result.

Classification of Regulators

The entire field of pressure regulation may be segregated into six types, namely:

Reducing Regulators.

Back Pressure Regulators.

Gas Fuel Regulators.

Pump Governors.

Vacuum Regulators.

Differential, or volume control regulators.

The primary duty of any regulator is to automatically maintain a given pressure within very close limits. The differential regulator maintains a given difference in pressure. Inasmuch as gas fuel regulators and pump governors operate and are constructed exactly like reducing regulators, it is only their application that is classified above. Of course, it is the limits within which it is desired to maintain this given pressure that determines whether or not the regulator should be pilot operated, and this matter rests entirely with the purchaser.

We will now analyze the operation and general application of each of the types mentioned.

Reducing Regulators

The duty of this type of regulator is to take the fluid as it is delivered to it at any pressure, reduce that pressure to the pressure desired and automatically maintain that pressure within very close limits. Reducing regulators are always governed by the outlet pressure, the diaphragm being connected to the outlet side. They are so constructed that as the pressure increases on the diaphragm, the valve mechanism closes and as the pressure decreases, the valve opens.

One of the common uses for pressure reducing regulators is for supplying a constant low pressure for gas-engine fuel. Until very recently it has been the practice to install two reducing regulators for furnishing fuel to gas-engine driven compressors. One regulator would reduce the pressure from 30 pounds, or whatever it might have been to about 5 pounds, and the second regulator would take this 5-pound gas and further reduce it to the desired lower pressure, which sometimes was as low as one or two inches of water pressure.

It is not considered good practice to make this pressure reduction in one stage. Not only is one regulator eliminated, but a much smaller regulator may be used. For example, where a two-inch high pressure regulator and a three-inch low pressure regulator would have been required by the two-stage method, one one-inch reducing regulator is sufficiently large to handle the job alone, and at about one-fourth the cost. The latest type regulators are just as capable of reducing 30 pounds to one ounce as five pounds to one ounce, and are equally as reliable. Of course, the same size header is necessary and the small regulator should exhaust directly into the header. The actuating pressure for the diaphragm should be taken off the middle of the header. This extremely low pressure permits the use of very large diaphragms with which remarkably accurate results may be obtained. For this reason it is unnecessary to use a pilot operated regulator for gas engine fuel.

A reducing regulator set to maintain the desired pressure can be installed at the inlet to any system in which a fluid pressure is carried with the assurance of protection against excessive pressure on the equipment. This pertains to instances where the incoming fluid is subject to fluctuation caused from an etexrnal and uncontrollable source.

Reducing regulators are used extensively by gas companies for feeding their low pressure distributing systems. Similar uses are made of reducing regulators by the oil companies where it is desirable to prevent excessive fuel line pressures.

Back Pressure Regulators

The action of regulators in this class is the reverse from the action of reducing regulators and the application is exactly opposite. Instead of maintaining a constant outlet pressure, back pressure regulators maintain a constant inlet pressure. Such regulators are also known as relief valves, check pressure valves and even the pop valve belongs to this class.

There are many uses for back pressure regulators in absorption plants. The most general appilcations are:

1. The blow-off regulator, for preventing plant pressure building up when no other disposition can be made of treated gas.

2. A regulator on each other line through which treated gas is transported, such as to lease fuel system and sales lines. This prevents the plant from suffering the fluctuations in pressure caused by increasing and decreasing demand for gas.

3. Back pressure regulators installed on gasoline storage tanks and high pressure and low pressure accumulators prevent the rapid vaporization of lighter hydrocarbons caused by any sudden release in pressure.

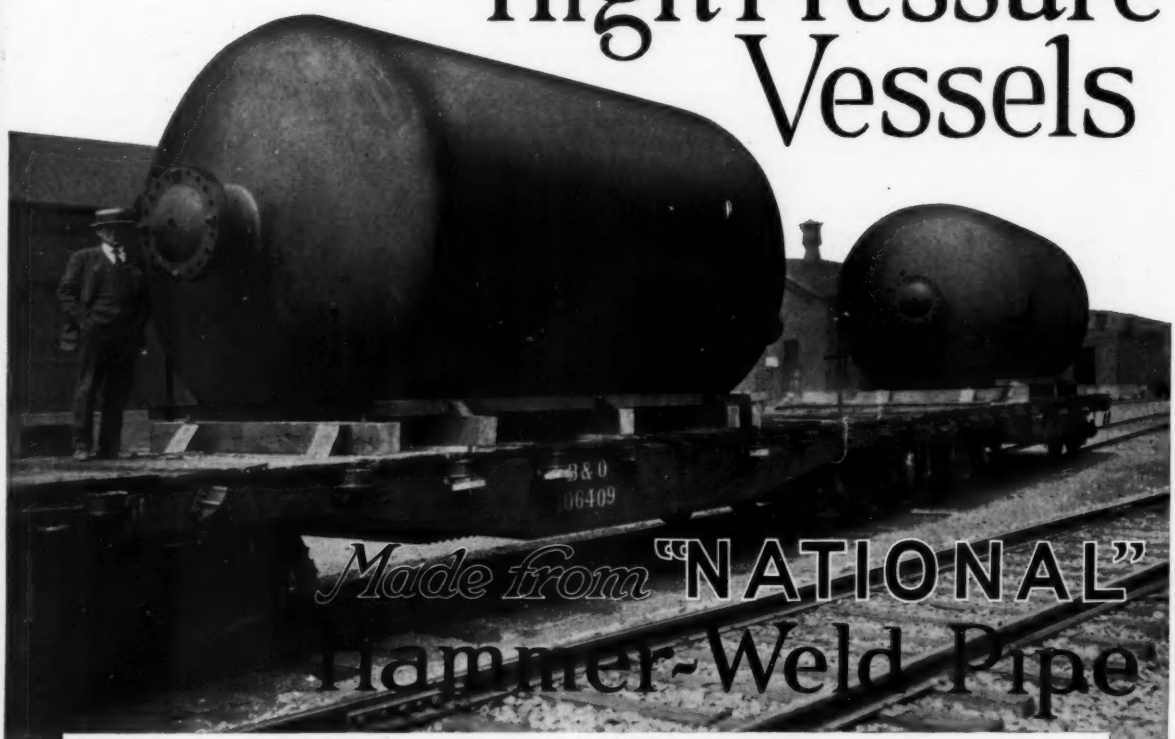
4. Any other equipment throughout a plant which operates at greater than plant pressure should be controlled at the outlet by a back pressure regulator.

This type of regulator is also used in the oil fields to maintain constant casinghead pressures or back pressures on gas and oil operators. Wherever a well is producing into a system in which the pressure fluctuates, these fluctuations affect the well pressure accordingly. Usually this condition is extremely detrimental to the well and may be eliminated by back pressure regulation.

The operation of back pressure regulators as compared with reducing regulators may be clearly defined in this manner:

Back pressure regulators relieve fluid from any system in the same quantities and at the same rate as such surplus fluid is being introduced; reducing regulators introduce fluid into any system in the same quantity and

High Pressure Vessels



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at the same rate as such fluids is being consumed or disposed of.

Gas Fuel Regulators for Steam Boilers

Gas fuel regulators are sometimes called boiler governors or gas steam regulators. Their purpose is to feed automatically gas to burners under steam boilers in such quantity as to maintain a constant given steam pressure under varying conditions of load. Their action, that is, the way in which they function, is similar to that of reducing regulators in that increased pressure on the diaphragm closes the valve mechanism.

Gas fuel regulators are installed on the gas header to the burners and steam pressure is connected to the diaphragm. The steam connection may be taken from the main steam header near the boiler or boilers, but preferably from the top of each boiler or steam drum, where the pressure is stationary. Constant steam pressure is recognized as being of vital importance to gasoline plant operation not only from the standpoint of efficiency but by eliminating frequent hand adjustments by plant operators.

This device consists of a balanced valve having two or four ports. The valve is opened by either a weighted lever or spring, and is closed by boiler steam pressure, thus admitting or shutting off gas as the demand for steam varies. As steam pressure tends to fall, the spring tension or the weighted lever opens the valve admitting more gas to burners, and as pressure tends to rise, the increased force on the diaphragm overcomes the spring tension, partly closing the valve, thus reducing the flow.

The pilot operated fuel regulator is recommended for large boiler plants of five hundred horsepower or more, but as previously alluded to in this paper, from the standpoint of efficiency, it is very important to maintain as even a flow to the burners as possible, and in some instances it is necessary to retard the sensitiveness of a pilot operated regulator to effect better combustion efficiency. This is especially true of smaller plants and plants subject to extremely variable steam loads.

Pump Governors

As the name implies, regulators of this type are to control the operation of steam-driven pumps. The valve is installed on the steam supply to the pump and the diaphragm connected to the pump discharge. As the discharge pressure of the pump slightly increases or decreases, the diaphragm mechanism closes or opens the valve, thus decreasing or increasing the speed of the pump to maintain the desired pressure.

Pump governors, boiler fuel regulators and reducing regulators are all similar in design and operation. Wherever it is desired to maintain a constant pump discharge pressure, a pump governor is required. In connection with this subject, we might cite a common application of this type of equipment—for controlling the output of compressors. A regulator of the reducing type can be installed on the suction to the primary stage with its diaphragm connected to the discharge pressure of the highs. The desired discharge pressure can then be maintained with the entire elimination of hand control, regardless of the size or number of compressors in the plant. In some cases, perfectly satisfactory results may be obtained by installing a small regulator on a bypass and throttle a greater portion of the intake through a hand valve on the main line.

Vacuum Regulators

The chief difference between vacuum and positive pressure regulators is in the diaphragm construction. The spring, or weight, must be so located that it opposes the force exerted by the difference between atmospheric and vacuum pressures. Briefly, vacuum regulators are made to function in two ways which correspond to the function of the regular reducing and back pressure instruments; that is, first, to close when the vacuum increases; or in other words, when the absolute pressure decreases. Second, to open when the vacuum increases. The first type would be installed on the outlet line from a system with the diaphragm connected upstream. The second type would be installed on the inlet line to a system with the diaphragm connected downstream.

As in the case of low pressure reducing regulators, such as are used to control gas-engine fuel, the low working pressures encountered in vacuum regulation permits the use of extremely large diaphragms, thus eliminating the necessity of pilot operated equipment.

Differential Regulators

All diaphragm operated regulators, whether equipped with weighted lever or spring, are in reality differential regulators, because in any case there are two pressures at work, one of which is generally atmospheric pressure. This latter pressure being comparatively constant, is sometimes forgotten as playing any part in the operation of regulators. Where pressures above atmospheric are regulated, the constant atmospheric pressure works to assist the spring tension. In the case of vacuum regulators, the atmospheric pressure opposes the spring tension, or weight.

The term differential regulators, however, is particularly applicable to a certain class in which both sides of the diaphragm are direct-connected to the fluid being controlled. This type of equipment has many uses, but mainly is used to control or maintain a desired rate of flow. This is accomplished by maintaining a predetermined difference in pressure between the upstream and downstream sides of an orifice installed in the line through which the fluid is passing. The differential regulator is installed on the same line, either above or below the orifice. The high pressure side of the diaphragm or, in other words, the side of the diaphragm opposing the spring tension, or weights, is connected to the upstream side of the orifice; the low pressure side of the diaphragm being connected to the downstream side of the orifice. The spring tension, or weights, are set for the desired difference in pressure. Changes in flow may be made either by changing the size of the orifice or altering the adjustment of the regulator. Such equipment is used to maintain a constant rate of flow of oil to absorption towers, or a given rate of flow of gas through a pipe line, etc.

Differential regulators are also frequently used in connection with wells flowing by gas lift, to maintain a constant delivery of dry gas to the well and in the case of heading wells, to automatically increase the volume of gas into the well as the well pressure builds up and vice versa.

Another type of differential regulator is the differential gas relief valve, which works in conjunction with a multiple orifice meter installation. In order to accurately measure an extremely variable flow of gas with orifice meters it is necessary to have a number of meters connected to different orifices by-passing the main meter and divert gas through the bypasses as required by the changes of flow. The differential relief regulator is designed to automatically open completely, thus placing another meter in service, when the differential becomes excessive, and to automatically close completely when the differential becomes so low that the additional meter is no longer needed.

In conclusion, it might be worth saying that each plant and distributing system has its peculiar operating conditions with which to contend and, consequently, it would be impossible to mention in this brief paper all of the special uses for regulation equipment.

Bulletin on Return Bends

The Ohio Steel Foundry Company has published a bulletin which illustrates and describes a new type of return bend for use in pipe stills and cracking units.

The new type of closure is called "Ohiolock." It can be used in any pipe still or cracking unit and is built to suit any pressure or temperature condition.

Copies of the bulletin may be secured on application from the company, The Ohio Steel Foundry Company, Springfield, Ohio.

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DEALING IN PERSONALITIES

California Natural Gasoline Association Elects

Los Angeles—The California Natural Gasoline Association held its first annual meeting in this city June 16 and elected the following officers: President, G. L. Ratcliffe; vice president, I. B. Funk; directors, R. E. Beckley, H. W. Parmalee and J. S. Watson.

Mr. Ratcliffe is with the General Petroleum Company. He succeeds Paul D. Barton, who was the association's first president. Mr. Funk is a consulting engineer and was formerly connected with the Union Oil Company of California. R. E. Beckley, H. W. Parmalee and J. S. Watson, the new directors, are among he leading natural gasoline men of the State.

The association was organized only one year ago and has had a phenomenal growth. The organization has 265 members, of which 65 are associate members. Active membership is limited to those who are actively engaged in the manufacture of natural gasoline.

C. L. Mayhill Goes With Anderson-Pritchard

Oklahoma City.—C. L. Mayhill, formerly with the Imperial Oil Refining Company, has become associated with the Anderson-Pritchard Oil Corporation. He was elected on June 15 as director in charge of refined oil sales.

Mr. Mayhill started with the Ohio Cities Gas Company (now Pure Oil Company) some ten years ago but shortly after became associated with the Imperial Oil Refining Company, which company he left as vice-president and general manager to join the Anderson-Pritchard organization.

C. H. Dresser, for several years sales manager for the Anderson-Pritchard Corporation, has been elected director in charge of industrial naphtha sales.

The officers of the Anderson-Pritchard Oil Corporation are: L. H. Pritchard, president; J. Steve Anderson, vice-president; P. H. Anderson, secretary and treasurer, all young men, but of much practical experience.

A newly elected director of the corporation is W. M. Sturges, recently of California and formerly of Texas.

Mr. Berry V. Stoll, vice president and in charge of refining, Stoll Oil Refining Company, Louisville, Ky., was married June 11 to Miss Alice Speed of Louisville. Mr. and Mrs. Stoll are spending their honeymoon in Europe with the plans to return to Louisville about the first of September.

A. S. RUSSELL, MANAGER EL SEGUNDO REFINERY, STANDARD OIL COMPANY OF CALIFORNIA.

L. D. Dimm Retires From Standard Refinery

Los Angeles, Calif.—The last day of May marked the retirement from service of one of the best known oil refinery executives in the United States, L. D. Dimm.

For the past eight years, Mr. Dimm has been manager of the Standard Oil Company of California's El Segundo refinery, which, with its sister plant at Richmond is the largest refining organization in the West.

A farewell luncheon attended by 24 Southern California executives of the Standard was tendered Mr. Dimm at the company's plant at El Segundo. Following the luncheon, as many of the employes as could be released were called together and presented Mr. Dimm with a beautiful watch, chain and knife as a token of their esteem. The presentation speech was made by H. C. Hanna, superintendent of the refinery.

Mr. Dimm's refinery experience began 37 years ago at Whiting, Indiana. He came to California for the Standard Oil Company in 1901 and was manager of the company's Richmond refinery for many years. In 1919, coincident with the expansion of oil production in Southern California, Mr. Dimm was transferred to El Segundo as manager of that plant.

He is succeeded by A. S. Russell, formerly chief engineer of the Standard's manufacturing department at Richmond.

L. D. DIMM, RETIRED MANAGER OF EL SEGUNDO REFINERY, STANDARD OIL COMPANY OF CALIFORNIA.

A. J. Pfister, formerly of the sales department of Bell Oil & Gas Company, Tulsa, has resigned to accept the position of manager of sales for the Akin Gasoline Company. Mr. Pfister succeeds Ray R. Rosier, who resigned to go with the Signal Gasoline Company.

Jack Delaney, plant control engineer with the General Petroleum Corporation, has taken over the duties of district superintendent of District No. 2, Gas Department, which covers the Ventura Avenue, Santa Fe Springs, Norwalk and Tonner absorption plants. This position was formerly held by C. A. Renz, recently resigned.

Shreveport.—D. F. Gerstenberger, superintendent of the Bossier City refinery of the Louisiana Oil & Refining Company, has resigned his position because of poor health. His duties have been assumed temporarily by General Refinery Superintendent S. Barna.

Tulsa.—Offices of the Rock Island Refining Company, operating a refinery near Duncan, Okla., have recently moved from Duncan to Tulsa, with C. C. Calvert in charge.

Los Angeles.—The Richfield Oil Company recently announced that it had purchased 20 acres of land adjacent to and just north of its present refinery location at Hynes (Rioco), California. The additional land will be used for the erection of more storage facilities.

No plan for regulating production can be complete unless it admits the fundamental value of cracking

To fail to take into account the production-possibilities of this — the most efficient method known for obtaining the most gasoline from the crude — is to ignore one of the principal factors in the situation

For cracking is here to stay Those men on whose shoulders will rest the responsibility of saving the industry from its present flood of oil will do well to base their refining calculations on a steadily increasing percentage of Cracking

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Mid-Continent Natural Gasoline Capacity Grows

By GEORGE REID

ACCORDING to recent surveys of the natural gasoline manufacturing industry in the Mid-Continent area (including North Texas, North Louisiana, Arkansas, Kansas and Oklahoma) the total capacity of gasoline plants has increased during 1926 from 3,275,170 gallons to 3,565,400 gallons—a gain of 290,230 gallons. The complete detailed list of all plants and operators in the Mid-Continent area indicates that in some areas, particularly Oklahoma, there has been many changes in plant capacities, plant ownership and plant location, with quite an appreciable sprinkling of abandonments and discontinuances. Entire installations have in many instances been moved from one location to another, and from one state to another state.

In the matter of compression plant installations for example, the trend of this type of plant capacity is still downward, due to the fact that the practice of conversion of such plants into the absorption system of manufacture continues over the entire area. In the accompanying table, 1, the trend toward lower capacity of compression type plants is distinctly shown, and since 1920 this type of installation has been steadily decreasing in total capacity. During the past year the compression plant capacity for the Mid-Continent area has decreased from 723,990 gallons to 713,050 gallons, a decrease of 10,940 gallons. During the same period the total capacity of the absorption type of gasoline plant has increased by 76 installations throughout the Mid-Continent area, from 2,551,180 gallons in 1926 to 2,852,350 gallons at present, or a gain in capacity of 301,170 gallons. This increase in absorption plant capacity is offset by the 10,940 gallon decrease in compression plant capacity, making the total increase in capacity of all plants in the Mid-Continent area 290,230 gallons during the year.

A summary of operations of gasoline plants located in Oklahoma, Kansas, Arkansas, North Texas and North Louisiana, indicates that in the Mid-Continent there are 659 gasoline plant installations. Last year the total of all types of plants was estimated at 569 for this same area, and these figures show an increase of 90 plants in the total number of installations during the past year. This information is given in table 2, showing the present number of plants in each district included in the Mid-Continent area, according to type, compression, absorption, or combination of the two systems.

Seminole Responsible

In Oklahoma at the time of the survey taken early in 1926, there were 180 absorption installations and 154 compression gasoline plants, and the combined total capacity of the two types of installations was 1,844,630 gallons. According to the latest resume of operations, Oklahoma now has 191 absorption plants, 159 compression plants and 20 installations of the combination type, totalling 370 gasoline plants with a total combined capacity of 1,955,650 gallons, which indicates an increase for the State of 111,020 gallons.

Perhaps 90 to 95 per cent of the increase in gasoline plant capacity in Oklahoma may be attributed to the rapid development of this industry in the new productive area of Seminole. In this district there are a great number of compression type plants extracting gasoline more or less secondarily, since the primary purpose of many of these plants is for the flowing of oil wells by the gas lift system. The gasoline is extracted as a by-product of the gas lift work and the present survey of gasoline manufacturing installation does not include the gas lift compression plants. The Seminole development, however, has been instrumental in bolstering up the State's production of natural gasoline much more than is indicated by the current surveys of the situation.

Table 1
PROGRESS OF OKLAHOMA NATURAL GASOLINE MANUFACTURE
1912-1924, Inclusive

Year	No. Oprs.	No. Plants	Compression	Comb. Comp. and Absp.	Absorption	Total Production Gallons	Gas M. Cubic Feet	Average Yield M.Cu. Feet	Average Value Per Gal Cents
1911	8	8	.....	.....	.....	388,058	144,629	2.68	5.40
1912	11	13	.....	.....	.....	1,575,644	701,044	2.25	6.03
1913	19	40	.....	.....	.....	6,642,968	2,152,503	3.00	8.94
1914	35	58	.....	.....	.....	17,277,255	5,738,549	3.01	6.44
1915	36	63	.....	.....	.....	31,665,991	8,791,881	3.60	7.46
1916	77	116	45,827,325	.....	2,532,277	48,359,602	24,749,454	1.95	12.13
1917	167	234	108,728,213	.....	6,395,211	115,123,424	84,719,941	1.35	18.71
1918	133	276	154,271,605	.....	9,428,945	163,700,550	78,322,307	2.09	17.03
1919	161	320	175,796,157	.....	14,198,881	189,995,038	100,776,135	1.89	17.01
1920	141	315	163,913,791	.....	14,943,138	178,856,929	85,167,518	2.10	17.50
1921	123	280	165,740,022	.....	19,600,720	185,340,742	88,380,172	2.10	11.9
1922	103	267	137,712,000	9,688,000	42,004,000	189,403,670	94,799,953	2.00	13.2
1923	108	279	138,455,000	.....	131,794,000	*270,249,000	136,563,000	2.00	8.5
1924	108	281	117,424,000	.....	183,638,000	*301,052,000	172,111,000	1.7	7.8

*Includes production of combination, absorption and compression plants and drip.

Table 2
SUMMARY OF OPERATIONS OF GASOLINE PLANTS
In Oklahoma, Kansas North Texas, North Louisiana and Arkansas for February 1 to March 1, 1927

Type of Plant	No. of Plants	Prod. Daily
Oklahoma—		
Absorption	191	1,374,200
Compression	159	442,350
Compression and absorption	20	139,100
	370	1,955,650
Kansas—		
Absorption	16	102,000
Compression	9	39,100
	25	141,100
North Texas—		
Absorption	122	767,800
Compression	42	206,700
Compression and absorption	23	207,700
	187	1,182,200
North Louisiana—		
Absorption	43	151,650
Compression	12	21,200
	55	172,850
Arkansas—		
Absorption	18	107,000
Compression	3	3,700
Compression and absorption	1	2,900
	22	113,600
Total	659	3,565,400

Table 3 shows the magnitude of the development in the new Seminole fields of gasoline plant installations and capacity—dealing with the recent erection of absorption plant only. In addition to those plants shown in the following table, there are several more absorption plants in the course of erection, and as the development of the several areas comprising the Seminole district progresses the number of absorption plants and the capacity of these will also increase. In the accompanying table there is listed 18 separate absorption plant installations near the towns of Earlsboro and Seminole, which have a total estimated capacity of 343,000 gallons.

Kansas and Texas

Capacity of natural gasoline plants in Kansas has shown a gain of 16,300 gallons during the past year, while the North Texas area, through the development of several new pools in the district has increased its plant capacity, according to the present survey as compared to last year's figures, but 200,000 gallons. Arkanass, on the other hand, shows a decrease in gasoline plant capacity of 4000 gallons, and North Louisiana installations show a decrease of around 40,000 gallons capacity.

Table 4 shows the companies operating natural gasoline plants in the Mid-Continent area which have a daily capacity of over 50,000 gallons. Of the

(Continued on page 106)

METALAYER

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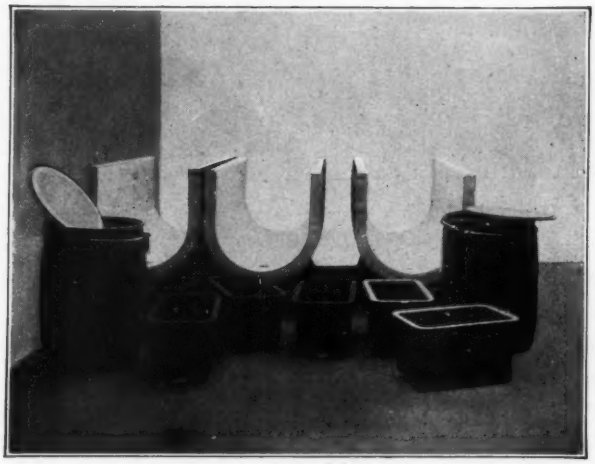

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—is extremely Versatile

This shows the varied classes of work done by ONE METALAYER WITH ONE OPERATOR IN ONE DAY. The work consisted of applying to the above mixers, steel barrels and cast iron tanks, coatings of Copper, Tin, Lead and Aluminum—surely this is convincing proof of VERSATILITY as well as production capacity.

METALAYER is daily helping over 1,500 manufacturers, with the following work: Filling up blowholes and chaplet leaks in Castings—Adding Weight or Dimension to Castings or mis-machined parts—Applying metallic Coatings for Resistance to corrosion or chemical action—Obtaining attractive and lasting Decorative Effects.

Briefly, METALAYER applies molten coatings of ANY of the commercial metals to ANY surface (whether inflammable, vitreous, fibrous, metallic, conducting or insulating) regardless of size, or shape. It can be used in the shop or in the field.

Undoubtedly there are numerous uses for METALAYER in YOUR PLANT either for production or maintenance work.

The quickest and most effective way to appreciate the value of METALAYER is to see it in operation, and we are always eager to arrange for that. If you can't come to our Plant for demonstration, the next best thing to do is to send for the METALAYER BOOK.

METALAYER, the process and the results obtainable by their use, are covered by Patents in all Countries.

METALS COATING COMPANY OF AMERICA

CLEVELAND-CHICAGO

495-497 N. 3rd St. Philadelphia

BERLIN AND HAMBURG GERMANY

Mention Where You Saw the Advertisement

NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS

Foos Company Announce Program for 1927

Springfield, Ohio—At a recent meeting of the board of directors of the Foos Gas Engine Company, a number of changes were announced:

The name of the company will be changed to the Foos Engine Company.

J. F. Baker was elected president and M. E. Baker was re-elected as secretary-treasurer.

New department assignments include Ray C. Burrus as sales manager, W. W. Schettler, chief engineer, and George F. Noltein, mechanical engineer.

The new program of the company includes the establishment of a factory at Tulsa, Oklahoma. In addition to carrying a large stock of engines and parts at this new branch, the branch staff will include sales representatives and service engineers.

It was also announced that the Pacific Coast representatives of the company, Garvey and Palmer, Inc., have practically completed the organization of the Western territory, having established offices in Los Angeles, San Francisco and Seattle.

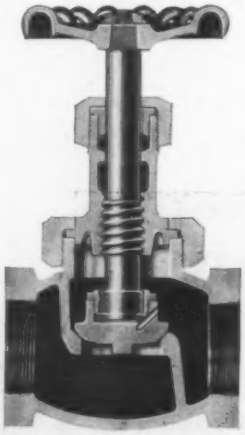
Bronze Bonnet Valve
OHIO INJECTOR COMPANY

The Ohio Injector Company, Wadsworth, Ohio, announces a new line of "O. I. C." extra heavy bronze union bonnet valves for steam working pressures up to 300 pounds.

In this type of valve, the body, bonnet, and union nut are made of special bronze and the stem is of a special stem metal. The disc is of high nickel bronze.

Special points of construction include liberal design in the parts forming the union, full pipe area, large diameter spindles, and heavy hexagons. Spindles are gland packed and equipped with ventilated, non-heating hand wheels.

Additional information will be supplied by the company on request.



"O. I. C." BRONZE BONNET VALVE

Waterous Literature
THE WATEROUS COMPANY

The Waterous Company, Saint Paul, Minnesota, manufacturers of fire hydrants and rotary pumps, have recently published a number of pieces of attractive literature on their products. These include a booklet on the Waterous Fire Hydrant and two catalogs describing the Waterous Rotary Pump. Copies of these may be obtained from the company, by request.

New Cork Covering
UNITED CORK COMPANIES

A new cork covering for cold pipe lines is announced by the United Cork Companies, Lyndhurst, New Jersey.

This covering is made of granulated cork, compressed and molded in sectional forms to fit the various sizes of pipe, and the fitting covers are molded to conform to the shape and size of the various fittings in ordinary use. It is finished with a coating of mineral rubber that provides a water-proof covering for all lines and fittings.

The covering is made in three thicknesses: Standard brine thickness, for lines where the refrigerant ranges from zero degrees F. to 25 degrees F.; ice water thickness, for lines where temperatures of 25 degrees F. and higher are carried, and special heavy brine thickness, for lines where the refrigerant ranges below zero degrees F.

Detailed information can be obtained by writing the company.

Refinery Map Ready For Distribution

Tulsa.—The Western Petroleum Refiners Association has completed its new statistical map, size 37 by 67 inches, showing the location, name, type, capacity, status and railway connections of all refineries in the United States as of January 1, 1927, and it is ready for distribution. This map also shows the various marketing territories, lists of refineries by states, shows the group within which its output, crude runs, and stocks are included in the government statistical reports and indicates those plants which are equipped with cracking units. Copies of the map will be sent to all members of the association, and copies will also be sold for a nominal cost to those interested outside of the association.

Magnifying Manometer
THE BACHARACH COMPANY

The Bacharach Industrial Instrument company, 7000-6 Bennett Street, Homewood Station, Pittsburgh, Pennsylvania, is marketing a new magnifying manometer that should be of special interest to refinery engineers and chemists.

This manometer magnifies the readings obtained with the mercury manometer. For a good many pressure readings, the heavy mercury moves too little to be read accurately, and on the other hand, the light oil would result in a gauge of unwieldly dimensions.

Magnifying manometers may be used where mercury alone gives too close a reading or where oil is impracticable.

The company will supply more information.

Metered Furnace Control
LEEDS & NORTHRUP COMPANY

An automatic system of metered combustion control for boiler furnaces is described in Bulletin No. 660, published by the Leeds & Northrup Company, Philadelphia. According to the booklet, an electrical current controlled by steam pressure and flow in the steam main co-operates with air or gas flow meters, furnace pressure meters, and stoker or fuel feeder meters to regulate stokers, fuel feeder meters, fans and dampers as required to preserve constant steam pressure, to secure the desired division of load among boilers, to insure the most favorable furnace percentage of excess air or carbon dioxide and to hold the most favorable pressure.

Copies of the bulletin may be obtained by request, from the company.

Adamant Refractory Gun
BOTFIELD REFRACTORIES COMPANY

Botfield Refractories Company, Philadelphia, has perfected a gun used to blow protective coatings on brickwork, known as the Adamant Gun.

This gun weighs less than four pounds and requires only one man for its operation. It uses air or steam at 50 pounds pressure or more.

To operate this gun the operator connects the air line to the one-half-inch standard pipe thread opening on the glove valve, places the supply pipe in the pre-mixture, turn the glove valve, and the gun sprays the pre-mixture where it is wanted.

More information on the gun will be mailed by the company, on request.

10"
18½"
Position of handle enables operator to direct mixture at any angle.
½" standard pipe thread opening can be connected to any air line.
Nozzle designed to lay material on wall smoothly and evenly, without sputtering
Regulating Wheel on the globe valve enables operator to control force of stream as desired.
Vent Pipe, open at upper end and passing through wall of the Supply Pipe, prevents clogging.
Supply Pipe to cut away at one side to permit easy entrance of mixture.

ADAMANT REFRACTORY GUN

concentrating on clean tubes

Various in design, but with a single aim—to smash, cut and tear scale out of tubes and pipes of all kinds—death on scale, but harmless to the tubes. Each suited to its particular task, these inveterate enemies of production-clogging scale, comes in all sizes and types.

Tubes for oil stills, boilers, heaters, superheaters, condensers, etc.,—tubes curved or straight, large or small, all have their aids toward low-cost operation in their appropriate Lagonda Cleaner.

We are tube-cleaning experts—ask us.

The Lagonda Mfg. Co.
SPRINGFIELD, OHIO.
FUEL SAVING SPECIALISTS
NEW YORK, CHICAGO, PHILADELPHIA, BOSTON, PITTSBURGH, CLEVELAND CINCINNATI, DETROIT, SYRACUSE, BALTIMORE
ST. LOUIS, KANSAS CITY, DENVER, DALLAS, ATLANTA, SAN FRANCISCO, MONTREAL, LONDON.

Makers of Lagonda Reseating Machines for boiler caps and headers, Lagonda Tube Cutters, and Lagonda Cleaner Feeding Device for curved tube boilers.

X-1417a

Safety Equipment Book

MINE SAFETY APPLIANCE COMPANY

The Mine Safety Appliance Company, Braddock Avenue and Thomas Boulevard, Pittsburgh, Pennsylvania, is now distributing a new catalog describing all the equipment it manufactures. This catalog features everything for mine and industrial safety. When writing for copies, ask for Catalog No. 3, Third Edition.

Pipe Joining Material

THE ALLOYS COMPANY

The Alloys Company, 121 Second Street, San Francisco, Cal., is marketing a new metallic base element for use in forming tight, leak-proof closures.

A powdered metallic lead has been devised, carried in a vehicle to give it consistency of a very heavy paint. The compound is suitable for application with a brush, and is said to pack into a solid mass under pressure in a pipe joint.

The mixture is said to be insoluble in acid, gas, oil, or gasoline.

Further information is obtainable from the company, upon request.

The Leavitt Machine Company, manufacturers of the Dexter Valve Reseating Machine, have announced the appointment of sales agencies for Louisiana and Arkansas as follows: Louisiana: Oliver H. Van Horn Company, Inc., 522-534 Camp Street, New Orleans, Louisiana. Arkansas: Hoshall Machinery Company, Fidelity Bank Building, Memphis, Tennessee.

Graver Staff Changes at Annual Meeting

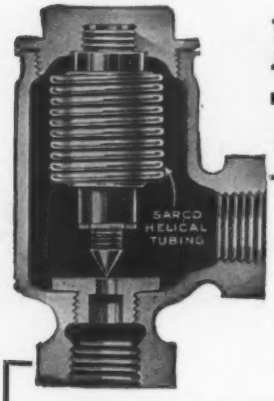
East Chicago, Ind.—A number of changes in the executive staff of the Graver Corporation were announced following the annual stockholders' meeting held recently:

W. F. Graver became president, taking the place of his brother, J. P. Graver, who is still active in the company, as vice president. P. S. Graver remains as first vice president in charge of the manufacturing operations. K. W. Bartlett is third vice president; H. S. Graver is secretary, and A. E. Lucius is assistant secretary.

Mr. Bartlett has been with the company for 17 years and was formerly general manager. Mr. Lucius was formerly the legal representative of the company.

The new president, W. F. Graver, has grown up with the business, having been schooled in the early days in every branch under his father, as has been the case with the other brothers.

W. F. GRAVER



Pay No Money—Take No Chances

You can be absolutely certain that the Sarco Steam Trap No. 9 will give you *entire satisfaction* before you pay us one cent—before you even obligate yourself to buy it.

We are so sure that the Sarco will do your work at least as well as any other steam trap at one-third the cost, that we will gladly send one on 30 days' free trial. Use it in your own plant—away from the influence of salesmen. Then if you are willing to part with the Sarco, send it back and we will thank you for making the test.

Hundreds of thousands of Sarcos have been sold on this "show me" basis. Surely, it's worth your while to find out, under the protection of this buy-it-only-if-you-like-it basis, whether the Sarco will save you money. You can't lose on this straightforward offer. We take all the risk.

Mail the coupon while you think of it.

SARCO COMPANY, Inc.

183 Madison Ave., New York City

Boston Buffalo Chicago
Detroit Cleveland Philadelphia

Adolf Frese Corporation, Los Angeles

SARCO STEAM TRAP

FREE TRIAL

SARCO CO., INC., 183 Madison Ave., New York
Send one Sarco Steam Trap on 30 days' free trial as follows:

( ) Size.....for pressure of.....lbs

( ) Send Booklet S-262.

Firm .....

Street .....

City ..... State.....

Smith Junior Catalog

SMITH WELDING CORPORATION

Smith Welding Equipment Corporation, 2619-33 Fourth Street, S. E., Minneapolis, Minnesota, manufacturers of welding apparatus, has just issued a Junior Catalog. It is of convenient pocket size and gives prices on oxy-acetylene equipment that is particularly suited to refinery use.

Copies will be mailed on request to the company.

Oxygen Manifold Catalog

AIR REDUCTION SALES COMPANY

Airco Davis-Bournonville Oxygen Manifolds are described in Catalog No. 6, published by the Air Reduction Sales Company, 342 Madison Avenue, New York.

Copies of the booklet will be mailed on request to the company.

Specialists In REFINERY COMBUSTION

LIENTZ Combustion Engineers have had years of experience in the designing of Refinery Installations. Many problems have been met and overcome—providing a knowledge that is of great value. Out of all this knowledge and experience has resulted the Lientz Recirculating System—a system which obtains more economical and dependable combustion for refineries. It will certainly pay you to investigate fully the many benefits you can obtain from this Recirculating System.

Insuring

MILD EVEN TEMPERATURES
LARGE VOLUME COMBUSTION GAS
INCREASED THRUPUT AND YIELD
REDUCED MAINTENANCE COST
A SUBSTANTIAL SAVING IN FUEL!

PROPERLY DESIGNED
—Based on Years of Experience

Lientz Engineers will be glad to counsel with you on your combustion needs. This, for new installations or for replacements. Why not take advantage of this opportunity and write us today. No obligation.

B. P. LIENTZ & COMPANY

KANSAS CITY, MO.
LOS ANGELES FT. WORTH NEW YORK CITY

The LIENTZ RECIRCULATING SYSTEM

Refined Products, Other Than Gasoline, Maintain Even Production Rate

PRODUCTION of kerosene has changed little since 1919, states G. R. Hopkins, associate petroleum economist, United States Bureau of Mines, Department of Commerce, in a recently issued report which reviews petroleum refinery statistics collected by the Bureau in the period 1916-1925. The output of kerosene in 1925 was 59,689,000 barrels as compared with 55,753,000 barrels in 1919. Increased use of kerosene in domestic heaters has counterbalanced declines in demand resulting from decreased use for lighting. Stocks of kerosene at refineries have, in general, been consistently reduced during the past 10 years. On December 31, 1926, these stocks amounted to 11,355,000 barrels, as compared to 7,121,000 barrels on hand December 31, 1925, a decrease of 37 per cent. Kerosene was the only refined product of any importance to show a decline in stocks during this period.

The recovery of gas oil and fuel oil has fluctuated only a little in the past 10 years; the output has increased in the same ratio as the runs to stills. In 1925, the railroads (class 1 carriers), consumed 58,520,000 barrels of fuel oil; refineries in their own operations, 50,455,000 barrels; vessels of the Shipping board, 12,570,000 barrels, the Navy, 7,404,000 barrels; electric public utility plants, 10,246,000 barrels; and gas manufacturers in enriching artificial gas, 23,000,000 barrels.

From 1922 to 1924 stocks of gas oil and fuel oil in California increased rapidly as a result of overproduction in that State, but the stocks east of California decreased, probably because of the growth of cracking at Mid-Continent and Eastern refineries. Stocks on hand December 31, 1925, were higher than on December 31, 1924, but were lower than on December 31, 1921. Exports and imports of gas oil and fuel oil in 1925 were, respectively, 32,509,000 and 12,245,000 barrels, both less than in the preceding year.

The output of lubricants and wax, though higher today than ever before, has not increased proportionately with runs to stills. As lubricants and wax are usually produced concurrently, they are liable to overproduction because they comprise higher percentages of the average crude oil than are required for domestic consumption and export. Consequently, their production has fluctuated more or less in accordance with stocks. Stocks of lubricants have increased steadily in recent years. Stocks of wax decreased in 1923 and 1924, but increased in 1925. The export trade in both lubricants and wax is relatively more important than that in the other major petroleum products; that is, a larger proportion of the output of these commodities is exported. During the past 10 years the equivalent of 64 per cent of the total production of wax was exported.

The production of petroleum coke in 1925 was 991,000 tons, an increase of 30 per cent over 1924 and of 145 per cent over 1916. Greater use of the cracking process has increased—through auxiliary coking of cracking stock—the output of coke, but this increase has been compensated by changes in refinery practice designed to eliminate its production. Strikes at coal mines and the introduction of briquetting have tended to increase the market for petroleum coke; nevertheless, the present output still exceeds the requirements for consumption, as is indicated by the increase of 144 per cent in stocks during 1925.

The production of asphalt has kept pace with increased runs of crude to stills. During 1925, the output was 2,677,400 tons, equivalent to 2 per cent of the total crude petroleum run to stills. Demand for asphalt for paving has been the largest single factor in maintaining the production of petroleum asphalt at a high level.

Besides the common refined products

22

TWENTY-TWO

Separate and Distinct Types
Of Water Tube Boilers
Have Been Equipped With The

CLEAN STEAM
TRACY-TIER
ANDREWS-BRADSHAW CO.
DRY STEAM

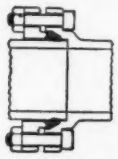
Also Practically All Sizes
And Types of H.R.T. Boilers

TOTALING MORE THAN
2,500,000 B.H.P.

(More than 50% of all orders during the past two years were repeat orders)

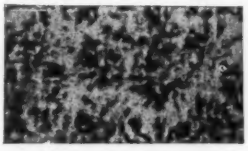
ANDREWS-BRADSHAW CO.
536 Fourth Ave., PITTSBURGH, PA.

SIMPLEX CAST IRON CONDENSER PIPING

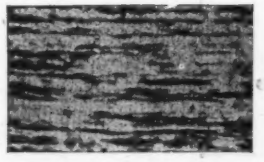


"ONE FLANGE IS LOOSE"

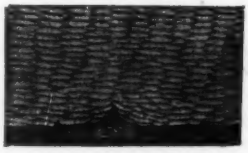
COATS ITSELF



Photomicrograph of cast iron, much enlarged, showing granular structure.



Photomicrograph of wrought iron, much enlarged, showing fibrous structure.



A piece of sheet steel, much enlarged, showing surface and sectional structure with a typical pit.

AUTHENTIC data from over 250 years of service prove that cast iron becomes coated with rust but remains practically unimpaired in weight and strength under conditions that are fatal to other kinds of metal.

Scientists believe this phenomena due to the microscopic structure of cast iron —a structure of the same granular or crystalline form as found in the iron ore from which it is made and which has laid unimpaired in the ground for untold centuries. Cast iron rusts on the surface, but the corrosive agent fails to break the natural mechanical bond between the irregular shaped granules, further oxygen is excluded by the first rust coating, and therefore corrosion stops. Cast iron literally coats itself.

In place of the interlocked grains or crystals of cast iron, wrought iron and steel are of a fibrous and, in thinly rolled steel, of a laminated structure, with distinct leaves overlapping each other. As corrosion takes place, these leaves or fibres scale off, constantly presenting a fresh surface to the corrosive agent.

Simplex pipe is flanged pipe minus the limitations of a joint made with rigid flanges. Thousands of feet of this material has been in use for years by the leading oil refineries of the United States for oil condensers.

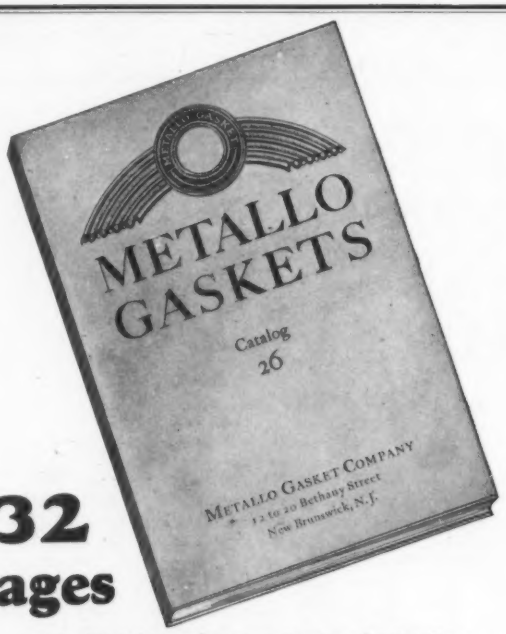
Write for Simplex Condenser Catalog Number 55

AMERICAN CAST IRON PIPE COMPANY

General Offices and Foundry: Birmingham, Ala.

Branches at
Dallas, Kansas City, San Francisco, Los Angeles, Chicago, New York,

Write Also for information on Our Prepared Joint Cast Iron Pipe for Oil Lines



32 pages

of useful information on gaskets and valve discs for all industrial services and valuable data and tables in this book we send free on request.

METALLO Gasket Co.

New Brunswick, N. J.

To Prevent a Vacuum

The *Fulton Duplex Sensitive Vacuum (or Back Pressure) Regulator* is designed for use on a system discharging gases to a line under light vacuum, where it is desired to maintain atmospheric pressure.

This Regulator acts as a safeguard when used on the vapor lines connected to storage tanks and prevents the pulling of a vacuum when adjusted as a vacuum regulator.

The same regulator may be adjusted to act as a *Duplex Back Pressure Regulator* and will control a slight pressure above atmosphere with the same accuracy as when used to control a light vacuum.

Send for catalogue.

CHAPLIN-FULTON MFG. COMPANY

28-36 Penn Ave., Pittsburgh, Pa.

just described, the petroleum refining industry makes a great variety of less important products, of which the chief examples are road oil and petrolatum. In recent years these miscellaneous oils have been classified as "All other finished products." Detailed statistics are no longer compiled by the Bureau of Mines, but the figures for total production show a decline in 1925 as compared to 1924.

Losses at the refineries have ranged between 3 and 5 per cent of the total crude petroleum run to stills. Losses in October, 1925, were running slightly above 3 per cent. The highest percentage of loss—4.5 per cent—was recorded in 1918. Improvements in operating practice, such as continuous treating, recovery of gasoline from refinery gases, and the use of improved equipment for reducing evaporation have been largely responsible for this decrease.

Detailed figures relating to the production of all these materials are contained in Bureau of Mines Bulletin 280, "Petroleum Refinery Statistics 1916-1925," copies of which may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of 30 cents.

Brown Company Opens Chicago Office

Chicago—The Brown Instrument Company, with headquarters in Philadelphia, has opened a Mid-Western repair and service station here, to take charge of the company's increased business throughout the Middle West.

The station is under the supervision of factory-trained mechanics and can give prompt repair service. Charts, thermocouples, protecting tubes, extension leads, instruments of standard ranges, and instrument parts from stock can be secured from the Chicago branch office.

Booklet for Boilermen

PLIBRICO COMPANY

"The Firebox" is a new house organ published by the Plibrico Jointless Firebrick Company, 1800 Block on Kingsbury Street, Chicago, Illinois. The magazine is published in the interest of those in charge of boilers and furnaces and contains interesting material pertaining to efficient and economical operation of furnaces.

Any one interested can be put on the mailing list by writing the company requesting this.

Pyrometer Control Book

THE BRISTOL COMPANY

Pyrometer Instruction Bulletin No. 358 has recently been released by the Bristol Company, Waterbury, Connecticut. This publication is devoted to the installation and care of pyrometers and is for free distribution. Copies will be mailed on application to the company.

SUNOCO

630 Absorption Oils 670

Increase your daily gasoline production. Lower your manufacturing cost per gallon of gasoline produced.

Control your end point.

THESE desirable results are obtained by careful control of the distillation range of these oils. A short boiling range provides a low molecular weight oil, which has greater absorption capacity.

Our Engineering Department will be glad of the opportunity to cooperate with you in the development of your plant.

The number of representative companies using Sunoco Absorption Oils are proof of their unquestionable quality. Let us quote you prices and furnish samples.

SUN COMPANY

Petroleum Bldg., Tulsa, Oklahoma

Refineries at

Marcus Hook, Pa. Yale, Oklahoma Toledo, Ohio

(Continued on page 96)

14 operating companies reporting large capacities, the Phillips Petroleum Company still maintains its lead in capacity, this company having 297,200 gallons capacity in Oklahoma, 231,400 gallons in North Texas, and 6,500 gallons in North Louisiana and Arkansas, which totals 535,100 gallons. The second largest producer of natural gasoline in the Mid-Continent territory is Sinclair Oil & Gas Company, with a capacity rating of 270,000 gallons, and Magnolia Petroleum Company is third with 204,100 gallons. The table shows the 14 leading companies with their production of natural gasoline distributed in the areas of the Mid-Continent, where the gasoline plants are located.

Table 4

NATURAL GASOLINE MANUFACTURERS

In the Mid-Continent Territory Having Daily Production of Over 50,000 Gallons—Covering Period February 1 to March 1

Company—	Oklahoma	Kansas	North Texas	North Louisiana and Arkansas	Total
Amerada Petroleum Corporation	70,000	7,000	3,200	.....	80,200
Carter Oil Company	131,500	.....	.....	.....	131,500
Chestnut & Smith	20,500	.....	130,000	.....	192,200
Empire Gas & Fuel Company	74,500	59,000	2,000	.....	135,500
Gypsy-Gulf	123,700	.....	55,200	17,400	196,300
Humble Oil & Refining Company	....	.....	79,300	.....	79,300
Magnolia Petroleum Company	65,100	.....	105,200	13,200	204,100
Mid-Continent Petroleum Company	63,800	.....	.....	.....	63,800
Phillips Petroleum Company	297,200	.....	231,400	6,500	535,100
Roxana Petroleum Company	163,050	.....	11,000	.....	174,050
Skelly Oil Company	68,500	.....	60,000	13,500	142,000
Sinclair Oil & Gas Company	249,000	15,000	6,000	.....	270,000
The Texas Company	65,600	7,500	23,000	1,000	97,100
Tidal Refining Company	35,500	10,000	15,000	.....	60,500
					2,361,650

Table 3

NEW ABSORPTION GASOLINE PLANTS

Included in the Recent Survey of 1927 Constructed in the Seminole Area

Company—	Section	Gallons Capacity
Amerada Petroleum Corp.	16-9-5	20,000
Amerada Petroleum Corp.	23-9-5	2,500
Barnsdall Oil Corporation	24-9-6	10,000
Carter Oil Company	15-9-6	20,000
Carter Oil Company	35-10-6	18,000
Carter Oil Company	34-10-6	20,000
Empire Gasoline Company	24-9-6	15,000
Empire Gasoline Company	34-9-6	15,000
Empire Gasoline Company	15-8-6	20,000
Empire Gasoline Company	13-8-6	7,500
Empire Gasoline Company	14-8-6	20,000
Gypsy Oil Company	16-9-5	20,000
Independent Oil & Gas Co.	26-9-6	15,000
Magnolia Pet. Co.	10-9-5	20,000
Pure Oil Company	26-9-6	24,000
Pure Oil Company	14-8-6	15,000
Sinclair Oil & Gas Company	35-9-6	80,000
Victor Gasoline Company	10-9-8	1,000
Total		343,000

Repair Parco Plant

Parco, Wyo.—The new Dubbs cracking plant at this town, which is replacing the one ruined by the explosion a few months ago, is making good progress in its installation. The concrete footings for the expansion chambers, each 40x60x10 feet and weighing 83 tons, are completed, and the 200 foot smokestack from one side of which a huge chunk was torn, is being reinforced with a six-inch concrete sleeve extending above the damaged section.

New Dubbs Unit

Chicago.—The British American Oil Refineries, Ltd., recently contracted for the immediate construction of a 1000 barrel Dubbs cracking unit, which will be erected at its Toronto, Ontario, Canada, refinery.

New Cracking Unit

Los Angeles.—The Western Oil & Refining Company of California has constructed foundations for a new cracking unit installation at its Wilmington, California, refinery. Necessary tanks for operation and storage are already in place and the cracking unit is to be installed at once.

Refractory Efficiency Gained at Lower Cost

— — that sums up the experience *of* Southwestern Refineries who use

Texas Fire Brick

Athens Brick & Tile Co., Athens, Texas

Texas Clay Products Co., Malakoff, Texas

Elgin Butler Brick Co., Austin, Texas

Write Any Office for Facts and Figures

Texas Fire Brick Manufacturers Association

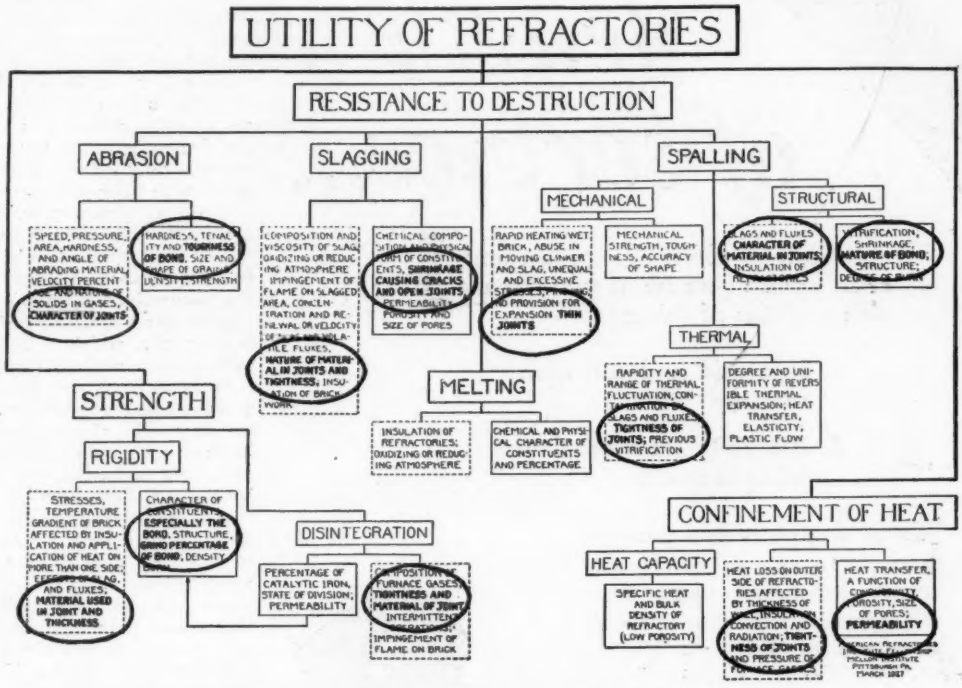
Promoting Texas Fire Brick Economies

Acme Brick Co., Ft. Worth, Texas

GLANCE at the diagram prepared by the American Refractories Institute.

NOTE the remarks in bold face type.

READ below why the joint and the bond are the important factors.



The Joint and the Bond are the Important Factors

This chart of the American Refractories Institute shows that resistance to destruction by slagging, spalling, disintegration, loss of heat, and strength depend on the material used for the joints.

The way to eliminate inefficiency and destruction at the joints in furnace walls, boiler settings, arches, is by laying up the firebrick with HYTEMPITE.

HYTEMPITE is especially preferable for laying up arch brick, one of the most severe tests for any cement. At high temperatures, HYTEMPITE prevents disruption due to pinching, which is often mistaken for spalling, as the top, bottom, and sides of the brick are held in place tightly, owing to the great strength of the HYTEMPITE BOND.

HYTEMPITE is particularly advantageous where large shapes are employed for these may be distorted to some extent and hence cannot be laid with thin joints. In this case, a mixture of HYTEMPITE with crushed old firebrick or GANISAND, as a filler, can be used to advantage.

HYTEMPITE forms a lasting union between refractories under all practical operating conditions.

QUIGLEY FURNACE SPECIALTIES CO., Inc.
26 Cortlandt Street **New York**

Quick Service from Stock in Every Industrial Center

Mention Where You Saw the Advertisement

length of service...

Aluminum Bronze parts last longer in service because of two remarkable qualities of this metal—

1. **It is acid and corrosion resisting**
2. **It is 250% stronger than other bronzes.**

This company are pioneer producers of aluminum bronze for many uses. We will cast and machine parts to your specifications.

Send Specifications for Estimate.

Buffalo Bronze Die Cast Corp.
100 Arthur Street. Buffalo, N. Y.

DBC

78 Oil and Refining Companies now using the

Mettler Entrained Combustion Gas Burners

For All Purposes, Kinds of Gas, Pressures

Write for Latest Condensed Catalog

Lee B. Mettler Co.

406 S. Main St. Los Angeles, Cal.

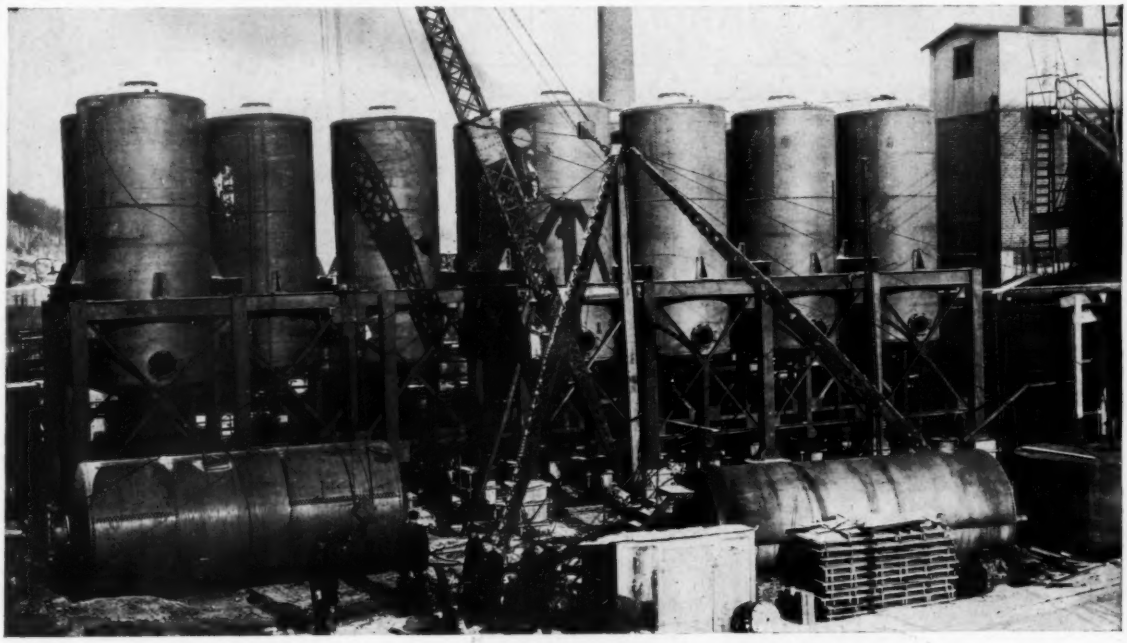
Blending of Distillates and Natural Gas Condensates

(Continued from page 57)

but deviations occur with concentration.

The blending of small amounts of petroleum naphtha with excessive amounts of very volatile natural gasoline, when heat is applied bringing the natural gasoline to its boiling point, or approximate point of total vaporization and applying sufficient heat to the naphtha so that its peculiar forces of molecular cohesion is very weak, seemingly accomplishes a molecular intermingling and closer contact, through the counter current scrubbing action in the evaporator, as previously described, which effects and causes the results as outlined herein. With heat and low pressures applied, and with the absorptive action of the gasoline vapors rising against a falling spray of hot naphtha, which is but slightly vaporized, the various series of hydrocarbons in both the naphtha and the natural gasoline may have opportunity to selectively absorb those members between which there is some affinity. The resultant solutions of hydrocarbons of the light gasoline series, (natural gasoline) and the heavier naphtha series, is an excellently stable product with a high distillation recovery, and very low in evaporation losses (low vapor tension). The naphtha, after repeated use, passing through the blending system several times shows but little change in its specifications as to boiling range and initial end point, while the gravity also remains but little changed. This indicates that there is a blending of the naphtha with a small quantity of the hydrocarbons of the natural gasoline which assists in maintaining the composition of the naphtha, at the same time that certain portions of the naphtha are lost by entering into solution in the natural gasoline and making up the blend or finished product. The naphtha does not actually remain unchanged, but the portion of naphtha dissolved in the blend is compensated for by a like blending of a small portion of natural gasoline in the naphtha. The volume of naphtha used, however, in the blend checks with the volume increase as noted in the finished product storage tanks very closely. The percentage of naphtha used in blending is determined by the gallonage increase in the finished product, as checked against the gallonage decrease in the naphtha storage tanks. Fresh naphtha is added to the system as needed.

In the installation described and others now in operation, the operators are securing a very stable product, of high distillation recovery, low end point, and relatively high initial boiling point, with low vapor pressures, through the use of small quantities of naphtha and in very much smaller proportions than would be necessary to accomplish the same results in lowered vapor pressure alone, with a cold or liquid phase blending procedure.



Hammond Filters with Fulton Patented Heads with Removable Non-Corrosive Monel Metal Screen. A Labor Saver doing away with old fashioned methods. Made in Diameters 5 to 10 feet and heights 10 x 30 feet. Names of users on request.

Our Bulletin No. 300 describes these Filters.

Our Bulletin No. 200 covers storage tanks from 300 to 80,000 barrels, and Bulletin No. 100R covers Horizontal Tanks from 1600 to 24,000 gallons. We make a specialty of furnishing steel tanks knocked down for domestic or export.

Erection men always available.

HAMMOND IRON WORKS

WARREN, PA.

Manufacturers and Exporters of Steel Tanks and Steel Plate Construction

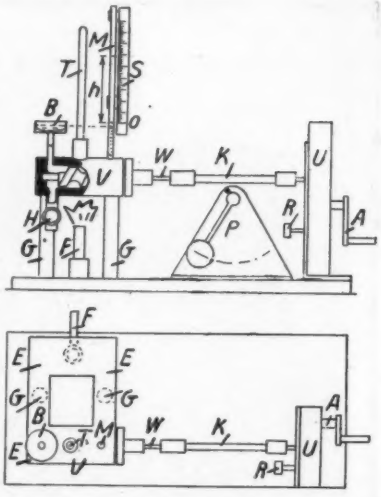
(New York Office: 17 Battery Place—Telephone 0060)

EXTRACTS OF REFINING TECHNOLOGY

New Simple Rapid Viscosimeter for Lubricating Oils

The measurement of the viscosity of lubricating oils with the aid of the Engler apparatus or the like, is a truly laborious and time-consuming operation and furthermore, is accurate as well, although the accuracy of the instrument plays no role in most practical cases. It is more convenient to determine the viscosity of the oil by means of the scale viscosimeter, an instrument which permits the continuous measurement of the viscosity at different temperatures, without the necessity of constantly transferring liquids as is necessary in the Engler viscosimeter. However, these scale instruments have as a rule been too expensive. The following is a description of a simple and new type of this instrument which requires only 30 cubic centimeters of oil to fill it and which is no more epxensive than an Engler instrument.

The viscosimeter is seen in the accompanying illustration. A massive measuring frame E stands on two supports G, firmly fastened to the baseboard. The front portion of the frame is bored for the introduction of the small viscosimeter vessel V, in which a small spindle can rotate with the shaft W. The oil, whose viscosity it is necessary to measure, is allowed to flow into the vessel V from a small container B. The manometer or measuring tube M extends vertically from V. The thermometer T serves for the determination of the temperature in the viscosimeter V. The oil can be removed from the viscosimeter through the petcock H. In back of the measuring board or frame is located the Bunsen burner F, this being fixed in one position. The frame E is heated by means of the flame of the Bunsen burner and along therewith the oil in the viscosimeter. The heating of the oil takes place with great uniformity in this simple manner, as is corroborated by various determinations made at rising and falling temperatures. This arrangement avoids the necessity of using the water or other liquid bath employed in the Engler viscosimeter.



In using this new type of viscosimeter, the container B is filled with oil and this oil is allowed to run into the viscosimeter, 30 cubic centimeters being sufficient for this purpose. If the consistency of the lubricating oil is like that of a paste, then the apparatus is heated up to the proper temperature. The process can then be carried out in such a manner that the oil is heated by means of the burner F in a regular fashion up to the maximum measuring temperature, 100 degrees C., or 200 degrees C., or even 300 degrees C., as one desires, each temperature being easily obtainable and allowable in the instrument. Then the burner F is extinguished. The oil now stands in the measuring tube M at the zero point, which is somewhat over the level of the oil in B. The zero point of the scale S, which is fastened to M, is set at this point. The spindle in the viscosimeter is then set rotating by means of the clockwork U, which can be

THE WATEROUS ROTARY PUMP

The Waterous Pump Is Easily Adjusted for Wear

In a few minutes and without disturbing pipe connections, the interior can be exposed for inspection and repair. The removal of a few shims makes the pump as good as new.

The Waterous is not a "competitive" pump. It is offered for continuous heavy duty and is built accordingly.

We would be glad to submit our proposal and specifications on your pumping requirements.

Pressures to 300 lbs.

Capacities to 2000 G. P. M.

Applications for representation in open territory will be considered from responsible parties.

WATEROUS COMPANY

SAINT PAUL, MINNESOTA

New York City Office: 342 Madison Ave.

Also Manufacturers of the Waterous Fire Hydrant

THE PRESIDENT WRITES -

The President of a Pennsylvania refining company in writing to *The* Refiner and Natural Gasoline Manufacturer comments on a number of articles carried during the past year and makes special reference to one article which he says has meant a material saving to his company.

Here is the letter:

"Rather than use the appended form, I am going to take what articles I have cut from *The* Refiner and Natural Gasoline Manufacturer and give you a list of them.

Cooling As Applied to Natural Gasoline Plants
By H. J. Maxwell, 1926.

Methods of Determining the Specific Gravity of Natural Gas
By Guy S. Mitchell, September, 1926

Cooling of Absorption Oil at Gasoline Plants
By E. R. Cox, February, 1927.

How to Conserve Steam in Refinery
By H. S. Bell, May, 1926.

Methods of Determining the Specific Gravity of Natural Gas
By Guy S. Mitchell, August, 1926.

Construction and Operation of Bubble Cap Towers
By Fred C. Koch, February, 1927.

Getting Finished Cuts from Single Tower
By George Reid, November, 1926.

"And, one article that I figure is saving for us about $100.00 per month in loading our tank cars. This is an old article which shows an arrangement of taking the evaporation gases from the storage tank back to the same tank from which the gasoline is being loaded. We were taking our vent gases from our tank car through our absorption plant with the result that the absorbent oil became so saturated with these lighter constituents that it was not possible for the oil to pick up the gasoline from the gas coming from the field. We now take our gas from the tank cars through a small compressor and with the piping arrangement shown in this article.

"We, personally, would like to see as many articles as possible on fractionation and more on general plant design.

Very truly yours,
THE SLOAN AND ZOOK COMPANY,
R. T. Zook, *President.*"

The Refiner and Natural Gasoline Manufacturer is one of three oil journals published by The Gulf Publishing Company, with a combined circulation of more than 24,000.

wound up by means of the handle A. The clockwork is connected with the shaft W of the viscosimeter spindle by means of the flexible coupling K.

The shaft makes 100 R.P.M., which can be controlled just to that point by means of the small pendulum P. The clockwork can be regulated by means of the regulating knob R. Just as soon as the spindle starts rotating the oil commences to rise in the measuring tube M and remains stationary at a certain height H. This height is proportional to the viscosity of the oil. The viscosity of the oil can be read off in absolute terms from the scale S, and also in degrees Engler, degrees Sayoblt and degrees Redwood, etc.

The measurement is thus carried out at a definite temperature. The temperature drop is then waited for and then the measurement is repeated at the new temperature. It has also been found that not all oils can endure heating to a temperature of 200 degrees C. without suffering change, which is at once detected in the very appearance of the oil. In the case of such oils the measurements are started at low temperatures and then the oil is heated up further. After the measurement of the viscosity, the oil is allowed to run out of the viscosimeter through the petocck h, the apparatus is washed out with a suitable liquid and is then ready for measuring another lubricating oil. Die Messtechnik, 1927, page 45.

Catalytic Cracking Process

The process, which is patented in French Patent No. 606,173, is concerned with the special treatment of hydrocarbons in the hot condition with aluminum chloride (anhydrous) with the idea in mind of producing gasoline motor fuel. There is nothing new in the use of aluminum chloride for this purpose, for a great number of processes have been described and patented in which this chemical is employed. However, aluminum chloride is used in a novel manner in this process.

The treatment consists in making the hydrocarbons, which are raised almost to the temperature at which they decompose, react not with aluminum chloride, but with the product obtained by the action of this chemical on certain hydrocarbons, which may be considered as by-products in the refining of crude oil with the aid of cold liquid sulphurous acid (Edeleanu process).

Ammonium chloride combines with the majority of hydrocarbons soluble in the cold (at a temperature of zero to 10 degrees C.), and yields an oil, an organic Ometallic compound, which is very active. It acts not so much as a catalyst of cracking as much as a regulator of the cracking operation.

This patent recommends the use of combinations of hydrocarbons plus aluminum chloride, free from sulphur and sulphurous acid, for this purpose.

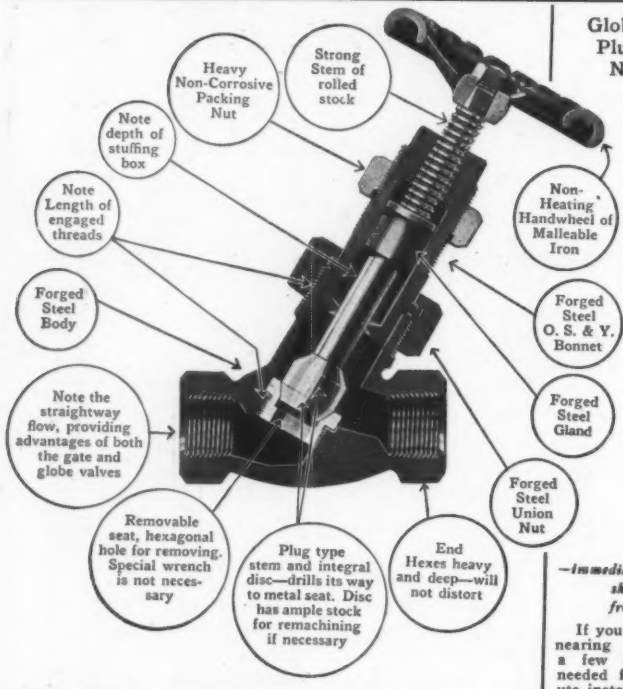
It is remarked that the use of a compound of aluminum chloride and a hydrocarbon derived from the Edeleanu process is an interesting development in cracking and constitutes a new use for these hydrocarbons. There is perhaps here indicated a new line of work in soluble metallic catalysts for the cracking process.

Utilization of Residual Oily Lyes

In order to recover the oils which are contained in the residuals from the treatment of petroleum with alkalies, the following method has been used, which had already been found to give results with kerosene residues. The alkaline residue is treated with one to two per cent of seasalt. The mass which separates contains 27 to 30 per cent of water and from 65 to 70 per cent of organic matters (oils, soaps, resins.) From 25 to 30 per cent of salt are added to this mass and it is then distilled in a still heated to a temperature of 300 to 310 degrees C. by direct superheated system. The distillation takes place with satisfactory rapidity and without the formation of foam. A tabulation of properties of the distilled oils is given in the original article. Laboratory tests have shown that the products obtained are of a very high grade.

When the process was carried out on a large scale, it was found that the product obtained was not clear enough and this was traced to the imperfect

Edwards Forged Steel Valves


Heavy Non-Corrosive Packing Nut
Strong Stem of rolled stock
Note depth of stuffing box
Note Length of engaged threads
Non-Heating Handwheel of Malleable Iron
Forged Steel Body
Forged Steel O. S. & Y. Bonnet
Note the straightway flow, providing advantages of both the gate and globe valves
Forged Steel Gland
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Removable seat, hexagonal hole for removing. Special wrench is not necessary
Plug type stem and integral disc—drills its way to metal seat. Disc has ample stock for remachining if necessary
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Globe Valve
Plug Type
No. 682

Here are two outstanding reasons why you should standardize on Edward Forged Steel Valves.

(1)—designed and built for service up to 500 pounds pressure and intermittent temperatures to 1100 degrees F.—they therefore will fit any service need within this range.

(2)—because of quantity production these high grade valves are priced LOW ENOUGH to justify their use even in service far below their maximum rating.

The Edward Valve & Manufacturing Company
Main Office and Works East Chicago, Ind.

Maintenance Engr. Corp., 1802 Conti St., Houston, Texas
Chapman Valve Mfg. Co., P. O. Box 974, Tulsa, Okla.

—immediate shipment from stock

If you have a plant nearing completion—a few extra valves needed for last minute installation — an emergency arises where valves are needed quickly—wire Edward — specify "Forged Steel Valves" — immediate shipment will be made — any quantity and any size from ¼-inch to 2-inch inclusive.

Edward Forged Steel Valves are made in both Globe and Angle pattern—Plug Type or Edward Protected Seat and Disc.

Ask for Refinery catalog.

—for every refinery service

Pyrometer Protection Tubes Thermometer Wells

Our long years of experience coupled with our complete manufacturing facilities enable us to produce Tubes or Wells second to none in quality—and at an economical price.

Those made of Hills-McCanna Corrosion Resisting Alloys are produced and drilled up to 42-inches long from a solid casting—while those of steel are produced from forgings or rod.

Where Hills-McCanna Alloys are used a tight joint is assured without the possibility of "freezing"—as well as quicker and more accurate readings due to higher thermal conductivity of the alloy.

Outline your needs and we shall gladly submit the alloy best suited to your conditions.

(The Wells and Tubes shown in this advertisement are from actual photographs and manufactured by us on order.)

HILLS-McCANNA CO.
2029 ELSTON AVENUE CHICAGO

TULSA, OKLA. WICHITA FALLS, TEXAS HOUSTON, TEXAS
LOS ANGELES, CAL. CLEVELAND, OHIO NEW YORK CITY, N. Y.

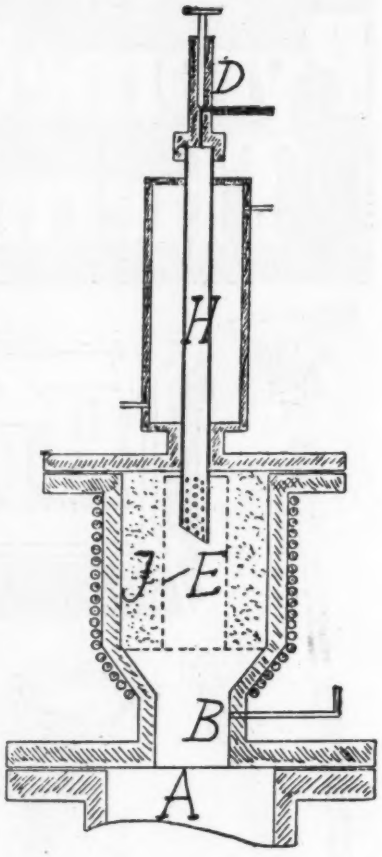
RECOGNIZED MANUFACTURERS OF REFINERY EQUIPMENT FOR 10 YEARS

design and construction of the still. Crude products were allowed to be carried along with the distilled vapors, thus contaminating the distillates. It was found that 25 per cent of the recovered oil could be advantageously mixed in all cases with 75 per cent of ordinary machine oil to obtain a lubricant of high quality, particularly after it had been subjected to treatment with sulphuric acid.

The naphthenic soaps which are left behind in the still are removed, washed with salt water and then decomposed with the aid of sulphuric acid. Naphthenic acids are thus obtained, which represent 85 to 90 per cent of the quantity present in the original alkaline residue. This product is darkened, due to the presence of 20 per cent of resins. Azerbaidj. Neft. Choz., 1926, Nos. 10-58, pages 50-52.

Cracking Mineral Oils

The illustration shows an apparatus, which is patented in German Patent No. 439,010, and which is employed in the cracking of mineral oils. This apparatus consists of an autoclave, shown at A, and a cracking device B, which is set on top of the autoclave. The cracking device B is also connected with reflux condenser H, which is provided with a reducing valve D. The cracking device B can be heated by the aid of electricity up to the temperature at which the oil treated is decomposed. The cracking catalyst is



located in an annular space J, which is formed between the concentric cylinder E in the decomposing space, and consequently succeeds in coming in contact only with the oil vapors and not with the return flow of liquid. German Patent No. 439,010.

In accordance with the additional patent No. 439,520, the heating of the catalyst is accomplished with the aid of internal heating. In this case the catalyst is a substance which conducts the electric current, such as carbon or coke, which is directly heated by the electric current. This is done by inserting the catalyst as resistance in the current circuit.

Resinification Value of Transformer Oils

It is corroborated that it is advisable that in examining transformer oils, the resin content should be determined both before and after heating. Of two oils which had the same resin content after heating, that which has the higher content before heating, and consequently showed the smaller increase, would probably prove the better in use. The acid value of the oil increases to about two and one-half times its original value during the heating, and is approximately proportional to the resinification value. Petroleum Zeitschrift, 1927, pages 116-7.

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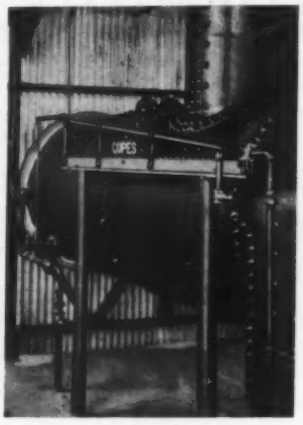
Boiler Feed Water
Regulators

"Pay a higher dividend than any other piece of power plant equipment."

L. L. Baker, Chief Engineer
Barnsdall Refining Co.



The Copes Provides:

A simple, rugged, accurate and continuous boiler feed water input.

Even distribution of load between boilers.

Less drop in steam pressure on overloads.

Higher overload capacity.

Smooth, constant rate of feed with no spasmodic opening and closing of the feed valves.

Drier steam, since the water level cannot rise beyond a predetermined point.

Elimination of boiler priming and wet steam at the filter department.

Labor saving.

Reduced stress on boiler feed pumps, feed lines and valves.

The above statement by Mr. Baker is from an article he recently wrote on "Advantages of Boiler Feed Water Regulation in the Oil Industry." A copy of this will be gladly sent you for the asking.

NORTHERN EQUIPMENT CO., 620 Grove Drive, Erie, Pa.

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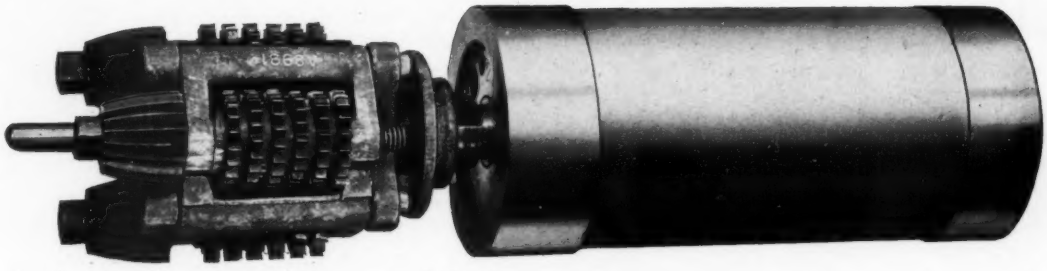
SYSTEM OF BOILER FEED CONTROL

ROTO TUBE CLEANERS



Roto Air-Driven Heavy Duty Cleaner
For

CRACKING STILLS

THE ROTO CO. **Sussex Avenue and Newark St.,** **NEWARK, N. J.**

SEAMLESS STEEL STILL TUBES

Thousands of Babcock & Wilcox open hearth seamless steel still tubes are in service in refineries throughout the country.

These tubes have been supplied to various specifications, either with plain ends or upset as ordered.

Many of them are thirty feet long, made hot finished by a process perfected by this Company, for tubes of unusually long length.

The more common sizes are carried in stock at the Mill for immediate shipment.

THE BABCOCK & WILCOX TUBE CO

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CINCINNATI .....Traction Building
ATLANTA, GA. .....Candler Building
NEW ORLEANS .....344 Camp Street
HOUSTON, TEXAS.....Electric Building
SAN ANTONIO, TEXAS .....
.....511 Builders Exchange Building
DALLAS, TEXAS .....Magnolia Building

THE BABCOCK & WILCOX TUBE CO. TUBES

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PHOENIX, ARIZONA.....Heard Building
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LOS ANGELES .....Central Building
PORTLAND, OREGON .....Gasco Building
HAVANA, CUBA .....Calle de Aguiar 104
SAN JUAN, PORTO RICO ..Royal Bank Building
HONOLULU, H. T.....Castle & Cooke Building

REFINERY AND GASOLINE PLANT ACTIVITIES

Skelly Panhandle Plant In Operation

Amarillo, Texas.—The new absorption gasoline plant of the Skelly Oil Company in the Panhandle of Texas was recently completed and placed in operation. The plant is located in block 88 in the heart of Skelly's 12,500 acre Schafer ranch lease in Carson County. The installation will serve a potential producing district of some 18,000 acres, which is insurance of a long operating life for the plant. Present capacity of this plant is given at 20,000 gallons daily, but work has already commenced which will result in doubling its size.

Natural gas is boosted through the absorption plant by a compressor station consisting of direct connected 320 horse power Snow tandem units.

Water for cooling purposes is supplied from large springs yielding soft water, which is piped to the plant a distance of nine miles.

A plant has been installed to treat the gasoline to sweetness, employing the sodium hypochlorite process. Electric power for auxiliary equipment is generated on the lease by the company. Electrically driven pumps are employed to circulate cooling water, and electricity is generated for lighting purposes at the camps for both the gasoline and production departments.

This cooling tower we installed for the Marland Refining Company at their Ponca City plant is the largest single atmospheric cooling tower in the United States

Plenty of Cool Water for All Purposes

Refinery engineers are finding that the best practice in regard to the use of cooling water is to have one large supply of cold water serving the various stills, interchangers, and coolers. However, these various pieces of apparatus empty their water into the hot well at different temperatures and present a cooling water problem that only an expert can solve successfully.

Our company is composed of engineers whose long experience with cooling water problems entitles them to your confidence. We have designed and built cooling towers and spray nozzle cooling systems for firms like Marland Refining Company, Union Oil Company, Roxana Petroleum Company and others equally well known.

Our new bulletin, just off the press, describes and illustrates our atmospheric cooling towers for refining plants. Write for your copy now.

Free on request

THE COOLING TOWER COMPANY, INC.

15 John Street New York

Houston, Texas
The J. A. Rossiter Co.,
410 Union Nat'l Bank Bldg.

Tulsa, Okla.
J. F. Pritchard & Co.,
910 Mid-Continent Bldg.

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N. O. Fleming Co.,
5815 Maywood Ave.,
Huntingdon Park

Representatives in other Principal Cities

Reconditioned Refinery Starts Operation

Tulsa.—The work of reconditioning the White Oak Refining Company's plant at Allen, Oklahoma, (formerly owned by the Mecca Refining Company) was completed and the plant started operations during the latter part of June. The company has also completed the laying of four miles of four inch pipe line from Allen to the Bowlegs pool in the Seminole area, and 2000 barrels of Seminole crude daily has been contracted from the Amerada Petroleum Company. The capacity of the refinery is rated at 2500 barrels. An operating force of 15 men is employed by the company. The new plant has a battery of ten stills, continuous operation, with six still equipment with bubble type fractionating equipment. Ample storage facilities are provided, with 11,000 barrels crude oil storage capacity, 6000 barrels gasoline and about 10,000 barrels fuel oil storage.

R. L. Walde, formerly superintendent of the Inter-Ocean plant at Bristow, is manager of plant operations for the White Oak Refining Company.

Start Work on Eastland County Gasoline Plant

Fort Worth, Texas. — Construction work has been started on a high pressure absorption gasoline plant by the Moody Corporation and H. H. Adams on the J. C. Dyer pool discovery lease in northwestern Eastland County. This plant is being erected by Hirt & MacDermott, Inc., on a turnkey contract, and will start off with a daily production of 3000 gallons. The gas produced in the Dyer pool averages one and one-fourth gallons of gasoline per thousand cubic feet. M. S. Eldred will be in charge of the plant. The owners of the plant have offices on the fourth floor of the W. T. Waggoner building, Fort Worth.

New THE SERVICE ACCURACY R.S.C. TULSA *Improved*

R. S.
Specific Gravity Balance

MORE RUGGED IN CONSTRUCTION
MORE POSITIVE IN OPERATION
SIMPLER TO OPERATE. EASIER TO CARRY

See for yourself

The Refinery Supply Co.

Largest Scientific Material House in the Southwest

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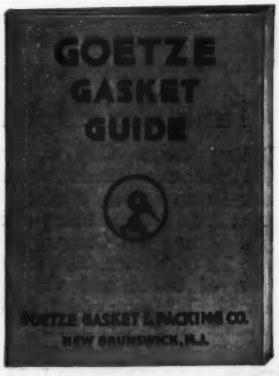
G O E T Z E



Metal-Asbestos Gaskets
for
Modern Refinery Practice

Write for this 36-page "Guide"

Goetze Gasket & Packing Co.

28 Allen Ave., **New Brunswick, N. Y.**

McKim Metallic Asbestos Gaskets

COPPER

ALUMINUM

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McCord Radiator & Mfg. Co.

Manufactures of McCord Force Feed Lubricators

DETROIT, MICH.

California—Chandler & Warden, 121 West Pico St., Los Angeles

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"SOCO" STATIONARY AND REVOLVING VENTILATORS

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Locate Second Refinery At McCamey

San Angelo, Texas.—A second refinery for McCamey and to operate on Crane-Upton County crude is to follow the dismantling of the Elliott Jones & Company's 4000 barrel daily capacity skimming and cracking plant, located at San Antonio. This plant was taken over in February by J. H. Frost, S. Searcy and others after being idle for a long period, and last week was purchased by the Southern Crude Oil Purchasing Company, subsidiary of Standard of Indiana. Southern will materially increase the capacity of the plant upon its removal to McCamey, where Southern is loading about 15,000 barrels of Crane-Upton County crude daily for tank car delivery to the Pan-American refinery at Destrehan, La. Humble has a 13,000 barrel skimming plant in operation at McCamey, and is selling the entire fuel output to the Southern Pacific Railroad on contract, making deliveries to the S. P. via tank cars at Alpine.

H. H. Cross Company Buys Plant at Joliet, Ill.

Chicago.—The Henry H. Cross Company, extensive marketers of petroleum products, are again entering the refining field through the purchase of the refining plant at Joliet, Ill., according to a recent announcement of George H. Fox, vice-president. The plant was formerly operated by the Warren Oil Company of Pennsylvania, and was later purchased by local people and operated for a while as the Joliet Refining Company. H. H. Cross Company plans to improve the plant, bringing it up to date and to increase the capacity.

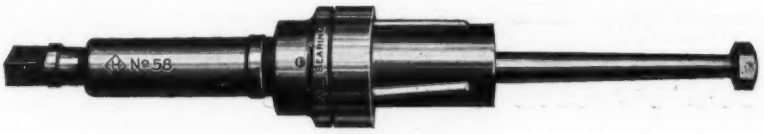
Tank Car Explosion

Dallas, Texas.—One workman was killed and two others burned when fumes in an empty tank car became ignited July 1 while being cleaned out at the Simms Oil Company's refinery here. H. B. Taylor, 28, died from the effects of burns and the explosion, while N. H. Mason and J. R. Shaddox were injured by the blast.

Rebuild Burned Plant

Gordon, Texas.—The Lone Star Gas Company, who lost one of their major natural gasoline plants here when it was destroyed by fire on June 14, is now rebuilding the plant and expects to have the new installation in operation by the middle of September. The plant had a rated capacity of 15,000 gallons of gasoline daily, and will be rebuilt to that capacity.

HEAVY DUTY EXPANDERS FOR STILL TUBES



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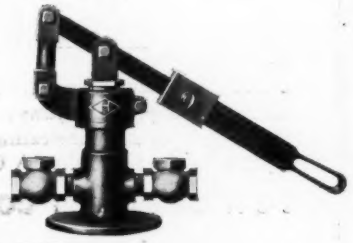

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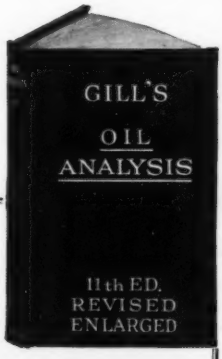

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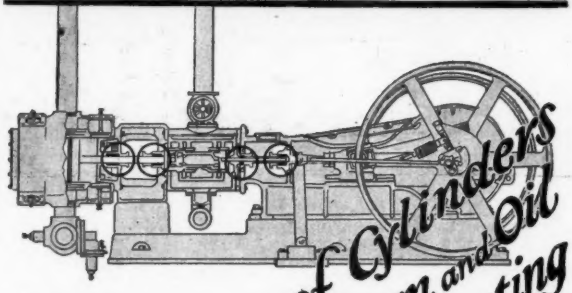

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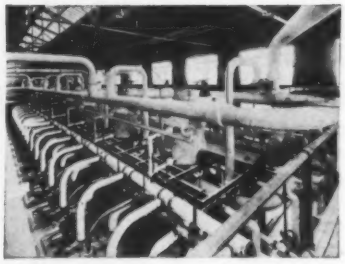

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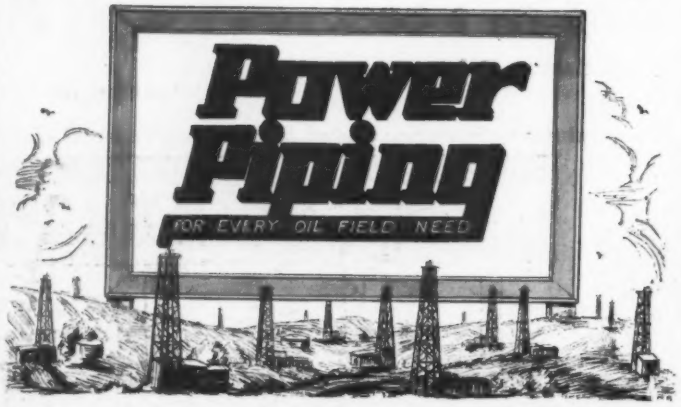


Signal Gasoline Company Opens Tulsa Office

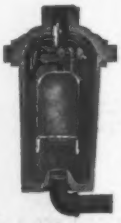
Tulsa.—The Signal Gasoline Company has established branch offices in Tulsa with Ray R. Rosier in charge. The office here is in the Exchange National Bank Building. Mr. Rosier was formerly sales manager for the Akin Gasoline Company, Tulsa, having served in that capacity during the past three years. Previous to the Akin connection, Mr. Rosier was manager of sales with the Western Oil Corporation. The Signal Gasoline Company has three natural gasoline plants in the Mid-Continent territory. The company is a California concern and is one of the major gasoline companies on the West Coast with headquarters in Los Angeles.

Will Strip Gas on Long Line to Kansas City

Tulsa.—The Empire Gas & Fuel Company has perfected detailed plans for the construction of an absorption gasoline plant which will work in conjunction with its compression gas transmission plant, now under construction at Wichita, Kansas, all of which is a part of the gas transportation system being built from the Panhandle fields to Kansas City. This line will have a capacity of 70,000,000 cubic feet for the first year, and it is planned to increase the number of compressor machines to the end that the capacity will be increased to 100,000,000 cubic feet. The gas from the Panhandle will be a mixture of relatively dry raw gases and residue gases from gasoline plants, and will naturally not be of high gasoline content. A recovery of .1 to .2 gallons of gasoline per thousand cubic feet is expected, and at this rate the gasoline production from the proposed gasoline plant installation will average about 10,000 gallons daily. The Empire's 20-inch line terminates at Wichita.

The United States Navy has awarded fuel oil contracts for 6,323,670 barrels to be delivered over the year 1927 to points along the Pacific Coast, Hawaii and the Philippine Islands; deliveries to start July 1. Companies sharing the bulk of the awards include the Pan-American Petroleum Company of California, General Petroleum Corporation, Standard Oil Company of California and the Associated Oil Company of California. Prices this year are the lowest for some time.

Schaffer Oil & Refining Company contemplates resuming operations at the refinery of the Alliance Oil & Refining Company's plant at Thermopolis, Wyoming, under the management of B. B. Channel of Thermopolis.



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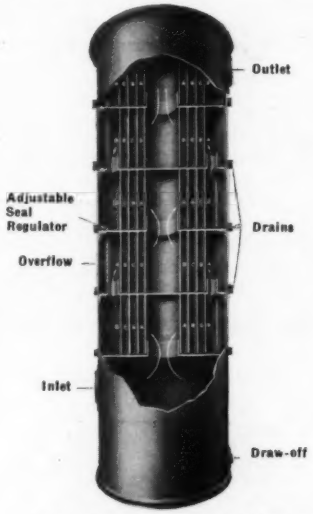

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Why the Seven O'clock Gauge?

SO the story goes—One day in the early antedeluvian days of oil refining, more than likely somewhere in the wilds of the first Pennsylvania oil fields, a refinery superintendent overslept. This was sufficient calamity for the day.

Upon arrival at the refinery, about 8:30 a. m. it is said, the superintendent, more or less peeved at the world in general because of the very bad example he had set through his late arrival, immediately growled "Where's my mornin' gauges?"

His office man, for once the early worm, was forced to confess that the guager was five minutes late himself, and the highly important seven o'clock guages were going to be "just a wee speck late." More calamity. What! No guages?

And so the superintendent—"Everything's wrong. Slept over myself; ate breakfast too fast and now my stummick hurts; that fool hoss of mine pu'possly kicked my shin, and the snow's two feet deeper'n t'was yestidy. And now no gauges."

As he seated himself to wait the errant gauger the right suspender strap snapped. Still no guages.

During the morning, while the snow fell furiously, and the wind whipped the stillmen's fires—two stills buckled, and one still "puked" (Good language in refinery circles). The smoke stack cracked open in an old rusted spot and the tank of kerosene turned yellow with devilish delight, but for no good reason. During the noon hour the superintendent's daughter eloped with a weed cutting yard hand. And this catastrophe, yes all this—because there was no seven oclock gauge.

Thus in these primal days was the beginning of tradition. Calamity has ever followed in refining circles when the 7 a.m. measurement of storage has been deferred. In the legends of refining, yesterday must cease at 6.59 and today shall start at 7 a.m. It is one tradition among refining plants; this mythical hour of today's beginning, which has so tightly encircled it with chimerical chains that the bonds are almost unseverable, and grave danger confronts him who has the temerity, the audacity, to open and close a 24 hour period at 8, or 9, or 10 a.m.

Years later, maybe 50, perhaps 75, historians differ, a rookie refiner, a yard man promoted to the office of gauger, in the heydey of Burkburnett development, coming into the refinery office after a cold rainy session of early morning gauging, asked his superintendent, "Why have I gotta get these gauges at seven a. m. when its so dark I can't see and so cold I can't .....

Sputters, and sputters only, interrupted,—but maybe the neophyte gauger was one of the 7,984 men found drowned in a tank of oil at Burkburnett during the boom.

How to Gauge an Ice-Covered Tank

Gauging tanks in the darkness of winter mornings certainly adds zest to living. Tens, twentys, 55's and 80's are hazardous contraptions. In balmy, summery, especially prepared Chamber of Commerce climates, many refiners have changed the location of gauge hatches, placing them close to the wall of the tank and within easy reach when the gauger stands upon the small enclosed steel platform at the top of the mounting steps. In colder sections, where winter is a regular and insistent visitor, this beneficial change has been much slower, and hatches remain five and six feet away from the tank wall and away from the safe enclosed platform.

Try gauging in the total darkness of a wintry 7 a.m. Mount the ice covered

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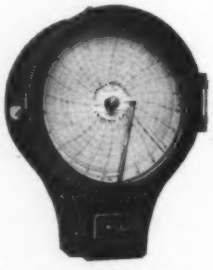

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In Gasoline tanks also in condenser boxes containing hot salt water use Rubshell Priming with Rubshell No. 1.

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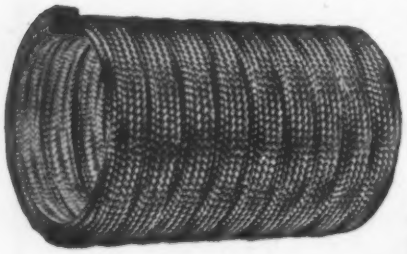

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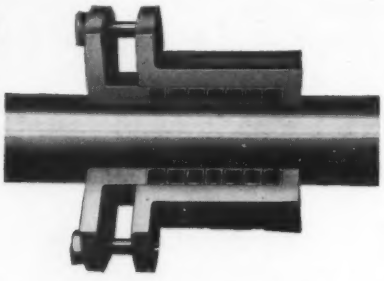

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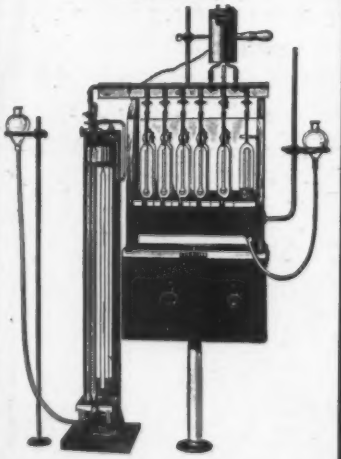

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steel steps climbing 30 or more feet into he cold blast of a northern wind. Crawl on hands and knees over a coating of slippery ice to raise the gauge hatch; which contrivance, according to certain physical laws, should counterbalance when raised and stay open,—but won't do it. Then place one foot on the knurled handle to hold the lid of the hatch suspended and open. In some unfathomable manner make the other foot support you on the slanting ice coated roof as you lean against the blizzard,—and don't slip. Place both knees tightly together, somehow, to hold the flash light between them so that its beam will guide your fumbling hands, instead of blinding you. If the flash light is placed upon the tank top, then it either rolls off the slanting roof of its own accord or volition, or the wind blows it to the ground,—and you never have an extra bulb. After this miracle of balancing and suspension is accomplished, your hands fumble for the steel tape (a cold and biting instrument). Find your blue chalk, for the tank is filled with 64 gravity gasoline,—mark your line and hopefully lower it into the tank. Bottom! Reel in quickly. But you're not quick enough for the low end point of the gasoline evaporates too fast and the dampened chalk is drying: with the result that you have no gauge at all. Try again. Again. Finally, "Well that must be right". Now by a series of contortions you pocket gauge line chalk, and flash light, while the rain and sleet beats down upon you and your frozen hands protest against such treatment. You release the hatch handle by removing the encumbered foot,—and as your feet slip suddenly out from under you; grab the hatch lid handle with both hands and hang there until the feet point toward the safety platform. Then slowly you slide to safety. But what the deuce was the gauge on that tank? What a rotten memory!

And there you are.

What time is 7 a.m. in the winter time? It's night time. And if a five dollar bookkeeper may have to wait a while on a six dollar gauger who is carrying around twenty five dollars worth of gauge line, thermometer and flash light,—stumbling around in a million dollar blizzard, risking a .... dollar life, and often lacking five dollars worth of safety devices,—what of it?

What started all this discussion?

On a recent visit to an operating plant, and one which has been running crude for some years, and showing a fair profit, the refinery gauger was seen making his rounds from tank to tank, and about 20 of them of all sizes and dimensions,—at 10 o'clock in the morning! certainly this malignant practice required investigation.

In the office the superintendent was found busy making drawings of a new

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tube still and estimating its cost,—all serenely indifferent apparently of the lack of his 7 o'clock gauges. The plant accountant, book keeper, or office man, whatever his title, was busily working on the pay roll, and sealed envelopes indicated that the morning's mail was taken care of. No one seemed worried. But our traditions! What a terrible shape they were in.

Accusing the superintendent of iconoclastic tendencies as a "buster of gauging traditions," the investigators were directed to the bulletin board in the pump house. Here a typewritten notice yellowed with age, read as follows,—

"Hereafter, the daily gauge on all tanks on the refinery yard will be taken at 10 a.m. This applies as well to the monthly inventory gauge which is taken for the monthly yield statement.

"Streams from the tail house will be switched from one run down tank to another at 10, instead of 7 a.m. and gauge taken on both tanks as usual.

"Those tanks from which oils must be pumped to the loading rack before 10 o'clock a.m. will be gauged by the pumper if such is necessary. Loading starts at 8 a.m.

"Do not gauge any tanks before daylight or during the night hours unless it is absolutely necessary, until the safety guards are installed on tanks. To avoid night gauging of fuel oil tanks, boiler supply tanks must be filled immediately after the morning 10 o'clock gauge. If it is necessary to switch crude oil tanks, do so during day light hours.

"Stay off of all steel tanks, agitators, stills, etc., during thunder storms.

When gauging tanks during hailstorms, blizzards of freezing weather, or during night hours, take a helper with you to assist in the work. This order must be carried out.

"Better be safe than sorry.

Signed .....
Plant Superintendent."

Building Refining Plant At Saginaw, Mich.

Casper, Wyo.—Standard Oil Company of Indiana is constructing a new refinery with a 2000 barrel charging capacity in the Saginaw, Michigan, field. G. M. Vandaveer of the pipe line department, Midwest Refining Company, has been in charge of the construction of a pipe line and gathering system for the field. The line consists of 5½ miles of three-inch and 15 miles of two and three-inch gathering lines. Field storage will consist of two 20,000 barrel steel tanks. Saginaw field has been developed in the last three years and is now about five miles in length and 2½ miles in width. Major number of the wells are on town lots inside the municipal corporation. The field has recently been extended to the east side of the river. Average depth of wells is about 1900 feet.

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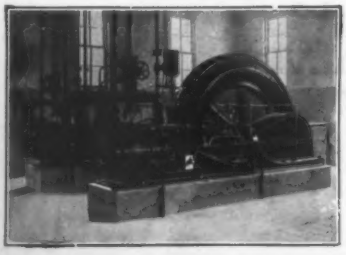

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Houston, Texas

Seminole Plants

Tulsa—The Empire Gasoline Company now has five gasoline absorption plants in operation in the Seminole area. The Lacey Gasoline plant was placed in operation during the latter part of June, which brought the number of operating plants up to five. This new type plant is located in Section 14-8-6, Bowlegs section, and is the main plant in the 8-6 area, having a rated capacity of 40,000 gallons of gasoline daily. Gasoline production from the company's Livingston and Davis plants, also in the 8-6 section of the field, is transported to the new plant and shipped from the latter location. Empire's first gasoline plant in the Seminole territory was placed in operation during the month of June 1926, and the tremendous development of the Seminole fields together with the large area involved has made the erection of these gasoline plants necessary.

New Tube Still

Lima, Ohio—The Solar Refining Company at Lima has under construction a new tube still and bubble type fractionating equipment. Arthur G. McKee Company, and the associated Widdell Engineering Company of Cleveland, Ohio are engineers and contractors on the installation. The new unit will have a capacity of 7500 barrels daily—running Lima and Illinois crude.

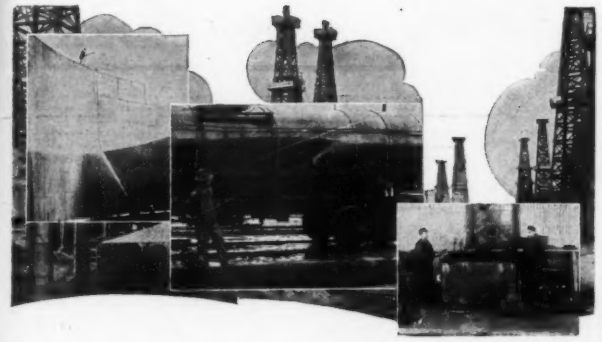
The fractionating equipment is designed to remove several cuts from the crude in one throughput—including gasoline, painters naptha, kerosene, two cuts of gas oil for cracking unit charging stock, and wax distillate which can be processed without re-running, and the fuel oil residuum. With the exception of continuous chemical treatment of the gasoline and other water white products the fractions will be finished in the one operation. The new unit is planned to begin operations about October 1.

Complete Charcoal Plant

Amarillo, Texas. — The Columbia Gasoline Company has completed the installation of a charcoal absorption gasoline plant in the southeast quarter of section 46, block 17, I. & G. N. survey in Wheeler County, Texas. The capacity of the new plant is reported as 6000 gallons daily.

DUBBS PLANT OPERATORS

Ten good Operators wanted for positions in California, starting about August 1st. Refinery located between Long Beach and Los Angeles. Applicants must have at least one year's actual operating experience on Dubbs' process. Address Box "A", Wilmington, Calif., giving education, age, experience and marital status, also name of present or last employer on Dubbs' process.



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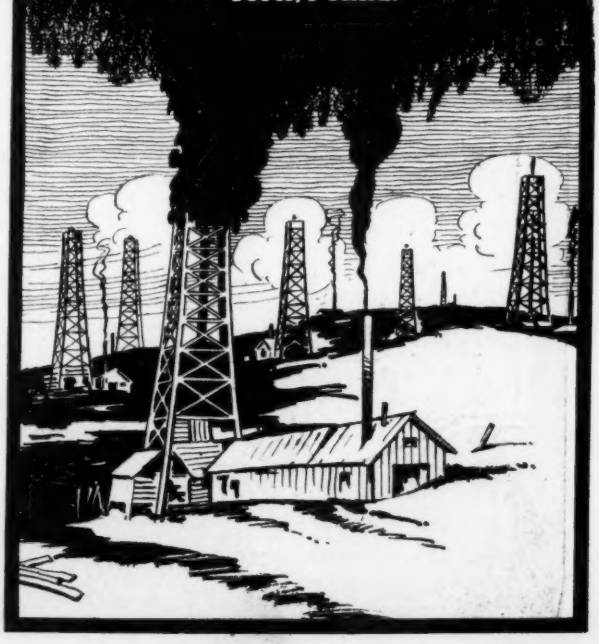

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It is Quality Controlled

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4. Lays flat on the floor.
5. Does not crack when rolled up.
6. Retains its grayish black color.
7. Round design of corrugation makes it easy to clean.

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CORRUGATED Rubber Matting is the most practical floor covering where heavy indoor pedestrian traffic is encountered. Indispensable as runners on wet days and will give ideal service in vestibules, halls, lobbies and elevators of public and private buildings.

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Restaurants	Schools
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Factory Buildings	Billiard Halls

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Palmyra, New York

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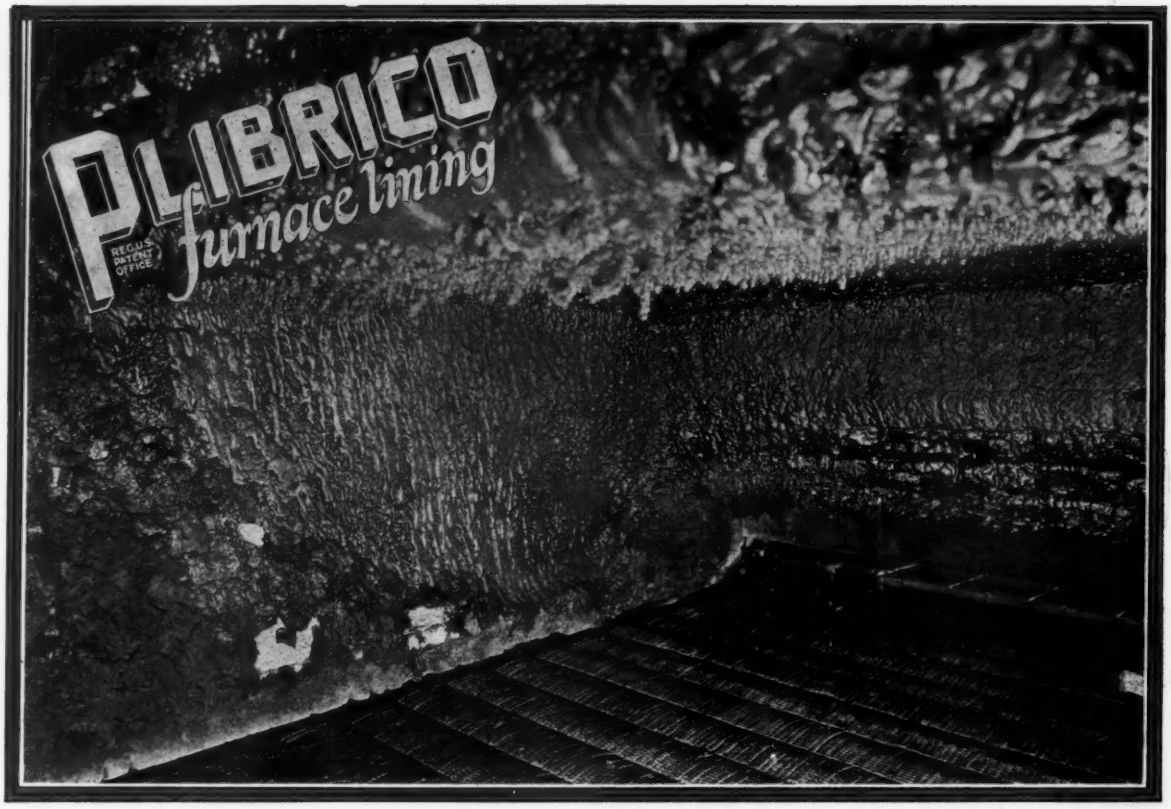

13,242 hours without repairs

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